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THE KIDNEY PROBLEM IN GENERAL SURGERY.*

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I want to speak about the kidney problem in general surgery and I shall explain some new ideas that first saw the light in this clinic and which should have a great influence upon operative results and indications.

We have long known that the fatalities in our clinic are kidney deaths, but the mechanical causes of this death have been known only for the last few years. Here, in this service, we have, more than others, the opportunities of studying the mechanism of the deaths from operation because all our patients have diseased kidneys and the majority of those who die after an operation, die from insufficiency of their kidneys.

As a matter of fact, the insufficiency of the kidney, that is to say, the principal cause of the death of our patients, consists in this: A great reduction in the quantity of urine in a patient whose maximum concentration is greatly reduced.

The reduction of the urine is noticeable after no matter what operation, major or minor. Now note the consequences. The patient, for instance, eliminated daily before the operation a thousand grammes of urine with a urea concentration of twenty grammes. The following day there is a reduction of five hundred grammes in the amount of the urine. In order to have the same elimination as before, the patient is compelled to increase the concentration of the urea in the urine to forty grammes.

Before: 1000 x 20 gr.=20 gr. urea
After: 500 x 40 gr.=20 gr. "

This is possible for the patient whose kidneys are good. The normal kidney is, indeed, able to increase the concentration of the urea to 55 grammes, which represents the maximum concentration, that is to say the highest concentration of which the kidney is capable in taking the urea from the blood. This idea of the maximum concentration, settled by Ambard and Papin in this clinic, has a great importance in the physyology and pathology of the kidney.

The formula of the maximum concentration (C. M.) measures the health of the kidney; if under physiological circumstances, the kidney is able to increase its power of concentration to 55 gr., it is not able, when it is affected, to increase its power to such a point. The decrease of C. M. is in proportion to the alteration of the kidney.

In the surgical patient whose kidneys are affected, the power of concentration has seriously decreased. This patient is unable to increase the concentration of the urea in his urine from 20 to 40 grm., if the C. M. is, for instance, represented by 20 grms. Five hundred grammes of urine with one maximum concentration of 20 grms. will give only 10 grms. of elimination every day.

After one operation, with the necessary modifications of the metabolism caused by the general anesthesia, it is not sufficient. When the elimination corresponds only to 10 grms., there is a retention corresponding to 10 grms: 10 grms. of retention in the organism gives 1 grm. of urea for every liter of lymph and of blood, so that the second day after the operation, we shall find 1 grm. of azotemy (retention of nitrogen) more than the amount shown before.

The third day, it will be the same, and the retention reaching the rate of more than 2 grms. the patient is exposed to a serious danger.

And it is easy to understand that the patient whose kidneys are affected before the operation will more quickly reach the point of azotemy, which will cause death.

In short, death after our operations, results frequently from a reduction of the quantity of urine in a patient whose kidneys are already affected.

Consequently it behooves us to know perfectly the working of the kidneys before the operation; in order to settle as exactly as possible the prognostics of our intervention.

But, what is the most accurate means of knowing the value of the kidneys?

The *analysis of the urine* has, now, no value; the amount of the urea in the urine depends upon the alimentation, upon the metabolism and, as we

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shall see, upon the blood urea contents. It does not signify anything, if we do not know the other important elements.

On the contrary, if we take into account only the concentration of the urea in the urine, we are unable to obtain any indications from the figures: for instance, 20 grammes are very good if this figure represents the average concentration of a patient who is able to increase his concentration to 55; this figure is, on the other hand, very bad if it represents the maximum concentration of a patient whose kidneys, being affected, are unable to increase the concentration above this figure.

The colored substances were considered for a long time as a good means of determining the working of the kidneys. Indeed, the means are very simple: after having injected under the skin a certain quantity of methylene blue or of the sulphonephthaléine, we obtain a coloring of the urine, blue with the former and red with the latter substance; and, according to the speed of elimination and the intensity and duration of coloring, we conclude to a certain degree the value of the kidneys. This conclusion has no scientific value.

Indeed, all colored substances follow the law of elimination of the nitrogens; and, as I shall tell you soon, the rate of the elimination of the urea is settled by the blood urea contents, and for the colored substances it is the same: consequently, in order to infer from the coloring of the urine the value of the kidneys, it would be necessary to settle a ratio between the colored substances in the blood and in the urine at the same time. But, the colored substances are unstable; they easily change their composition so that it is preferable and easier to choose the urea in order to know the value of the elimination of the colored substances, than to study the elimination of the colored substances in order to know the urea function.

The determination of the blood urea content is under certain conditions an accurate means of appreciating the working of the kidneys.

Indeed when the "azotemy," that is to say the quantity of the nitrogen in the blood increases above 1 grm., it is certain that the kidney function is seriously affected. On the contrary, for the azotemy less than 1 grm. the same conclusion is not so exact. The increase of the urea in the blood results from several factors and not only from the alteration of the kidneys; so that it is not possible to infer from the azotemy with scientific precision the function of the kidney. It is necessary to have at the same time the ratio between the blood urea content and the rate of the urea in the urine.

The elimination of the urea depends upon two laws settled by Ambard: first, it is proportional to the square of the azotemy; second, it is inversely proportional to the square root of the urea concentration in the urine.

And if we determine at the same time the blood urea content (Az) the concentration referred to 25% (C) and the rate of the urea in the urine (D), we obtain the following formula of Ambard: (we also add the intervention of the weight referred to 70.)

$$K = \frac{Az.}{\sqrt{D \times \frac{70}{P} \times \frac{\sqrt{C}}{25}}} = 0{,}070^*$$

This figure represents the normal working of the kidneys.

In the pathological circumstances, this figure increases so that approximately a constant of 0,100 represents the half of the kidney function. With 0,140, we have only one-third of the function; with 0,210 the reduction increases almost to the ninetieth (90th) of the function.

Thus with the information of the constant, we may appreciate the value of the kidneys before an operation and define the prognostics of our intervention as regards the urea kidney function.

We must observe that the constant does not give more than the value of the urea function; as regards this observation I wish to point out: that the constant does not give the water function, and in order to know fully the function of the kidneys, we are obliged to study the water function, with special exploration which on the other hand has not the same value as the constant for the urea.

Actually, we have not any accurate means of knowing the quality of the kidney water function, and as the urea always depends upon the water we never obtain complete security about the function of the kidneys. However, after having disposed of this observation it is possible to define the employment of the constant in surgery, with two examples; first, for a nephrectomy and, second, for a prostatectomy.

The majority of our nephrectomies are based upon the indications given by the catheterization of the ureter.

But, in some cases, this catheterization of the ureter is impossible, e. g. the bladder is too sensitive to receive the necessary quantity of water, the ureter orifices can not be discovered, it is impossible for the catheter to enter sufficiently the ureter, etc.

*Az=Azotemy; D=The rate of the urea in the urine in a given time; P=Weight.

What is to be done in such cases?

Formerly we tried to improve the state of the bladder; but it is always difficult on account of the bacilli which always come from the kidney into the bladder.

We have now with the constant a means of determining quickly the problem of the nephrectomy.

According to the clinic teaching, we consider the painful kidney as being the diseased one. We examine the patient and suppose the painful kidney is the affected organ. At other times we see by radiography a shadow in the region of the kidneys and we infer from that the alteration of the corresponding organ.

And having so settled the localization of the disease, we have no more than to define the kidney value of the opposite side; and here, the constant is to us absolutely necessary.

Two cases are to be considered.

1. The constant is below 0,100 and disease is unilateral. The nephrectomy of the altered kidney may be made with the fullest security.

2. The constant is above 0,100; this proves that the lesions are bilateral, that both kidneys are affected unequally, but the gravity of the disease is in proportion to the increase of the constant.

Nephrectomy is not forbidden, but it is necessary to pay great attention, above all, to the high figures of the constant.

Sometimes, students ask me: "At what figure do you operate, at what refuse operation?"

I can't answer; indeed it is a question of the increase of the constant and also of the interpretation of the alterations revealed by the constant.

As I previously said a constant of 0,140 corresponds to a reduction of 75% of the kidney function value. With this figure the nephrectomy exposes the patient to some dangers.

But it is also a question of a distribution of the lesions.

If the affected kidney is completely destroyed, so that it has no value, the nephrectomy may be made without notably changing the condition of the patient. The other kidney continues after, as before the operation, to assure the necessary elimination of the organism, and if the operation produces neither bleeding nor infection, nor intoxication by the anesthetic, the cure may be effected no matter what the figure of the constant may be.

On the other hand, if the most affected kidney still retains some functional value, the nephrectomy will impose upon the individual a corresponding reduction of the kidney function; and the other kidney will perhaps not be sufficient to permit a recovery.

It is always impossible to make this distribution of the lesions in advance.

But, in the course of the nephrectomy, if the surgeon has the kidney in his hands, he must appreciate the value of this kidney and conclude from its alteration as to the possibility, or impossibility of a nephrectomy. And I give to my assistants the following formula: "With the increase of the figures of the constant, the danger is greater as the alteration of the kidney to be extracted is less serious. The fullest security for the surgeon consists in finding a kidney quite destroyed."

Whatever the case may be, the constant in this matter constitutes for us a very great progress, permitting us to undertake a nephrectomy in some cases where it would otherwise be impossible to make, without the catheterization of the ureters, a prudent decision; and to push the indication of the nephrectomy to the most extreme limits.

The employment of the constant in *prostatics* is not governed by the same rules as in the cases of patients exposed to nephrectomy.

From this point of view, prostatectomy is not comparable with nephrectomy; the first does not take away anything of the kidney function; but the operation nevertheless may have a serious influence upon the working of the kidney, so that it is always necessary to study the value of the kidneys before the operation.

Three cases are to be considered according to the constant being above 0,200, below 0,100, between 0,100 and 0,200.

1. *When the constant is above* 0,200, it is preferable not to operate.

Without affirming that the operation will prove fatal, still there is always a great danger from the point of view of the kidneys.

We have been able to cure a patient having this reduction of kidney function, but another patient died very quickly after the operation from uremia.

Therefore, in our opinion, it is preferable not to operate.

2. *The constant is below* 0,100. The case is fairly favorable, the danger coming from the kidney is as small as possible; but we may not have complete security for some patients.

Those who, before operation, had a normal figure for the constant, may die through the kidneys, as sometimes there is *after the operation* a disturbance of the kidney function due to particular fragility of the kidney parenchyma, and the resistance of the kidney is not the same as the function:

the constant gives us the measure of the function; it does not inform us of the resistance of the kidney; so that there will be some deception from this point of view.

3. *The constant is between* 0,100 and 0,200; This is the most difficult case. Some people ask me: at what figure do you operate? I can't answer because one must always individualize.

However, it is possible to settle some general rules having a great influence upon our determination.

First, the constant is not everything; it indicates only the function of the kidneys, but the general state is also to be considered. It is preferable to operate upon a patient with a bad constant and a good general state than upon another with a good constant and a bad general state.

Second, the constant is never definite; it is always possible to improve it by régime, by the treatment of retention and infection. The patient must be operated upon under the best conditions possible for the disease so that it is always a good thing to prepare the patient for the operation, and the constant will show by its improvement the benefit of the preparatory treatment.

Third, when it is not possible to improve the constant its increase obliges us to utilize some measure to reduce the dangers of the operation. For instance, the prostatectomy in half the cases, local anesthesia in the other, will be in some measure indicated in order to reduce the dangers foreseen according to the constant.

We may affirm that with a certain figure of the constant the operation is impossible. But the benefit of the high constant consists in giving us some precious indications concerning the resistance of the individual and concerning urea, by which we may correct this deficiency of the organism.

KIDNEY FUNCTION IN PROSTATECTOMY.

It must be realized by one about to undertake the performance of the surgical removal of the prostate gland, that, as a rule, these patients, because of their age and of the usually associated pathological lesions of the heart and kidneys with resultant poor resistance to shock, hemorrhage, and sepsis, form a class of the most unfavorable surgical risks, and that, not only upon the operation itself, but far more upon the functional capacity of the kidneys, heart, and general circulation, does the mortality of prostatectomy depend. This is, then, an operation that requires skillful attention to and consideration of details.—EMIL C. ROBITSCHEK in *The Journal-Lancet.*

NOTES ON THE DIFFERENTIAL DIAGNOSIS OF VARIOUS TYPES OF RENAL HEMATURIA.*

A. HYMAN, M.D., F.A.C.S.,
NEW YORK CITY.

In a study of renal hematuria it will be found convenient, from both a clinical and a pathological point of view to divide the cases into two large groups. In the first, could be placed those cases which account for the greater number of hemorrhages, viz, stone, neoplasm, tuberculosis and hydronephrosis. In the second group may be classified cases, by no means infrequent, in which the above conditions can readily be excluded, and in which no gross organic lesions are to be found. On account of the vague and apparently obscure cause of these hemorrhages, this type has been designated symptomless, essential or idiopathic hematuria. In other words, to cloak our ignorance of the real underlying pathological causes a terminology was applied, which in the light of more recent investigations, has been found to cover a number of distinct pathological processes.

A true essential hematuria probably does not exist; it would imply a kidney showing absolutely no minute organic changes. More careful pathological examinations have recently demonstrated that a lesion is present in all cases. Up to within a short time ago, it was the exception rather than the rule, to excise specimens from kidneys at operation, for microscopic studies. No gross lesions being found, it was assumed that there were no organic changes. Later on, sections of the kidneys, or the extirpated organ itself, were subjected to careful microscopic examinations, with the result that changes in the cortex, indicative of a true nephritis, were frequently found. Thus, in time, essential hematuria came to be considered a manifestation of a chronic nephritis. More recent studies, however, have demonstrated that frequently the bleeding is the result of an acute or chronic infectious process showing but few pathological changes in the cortex, but a marked inflammatory reaction involving the medulla and pyramids. As a result of the inflammatory process caused by infections, fibrotic changes take place, which eventually interfere with the return venous circulation. This results in venous stasis; causing hemorrhage by diapedesis or by actual rupture of the capillaries[1]. In two cases recently reported by Quimby[2], in which the kidney had been removed for severe unilateral bleeding, complete pathological studies were made. In both

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instances the source of the bleeding was from the dilated thin-walled capillaries and veins situated just beneath the epethelium of the pelvis and pyramids. The cortex was not involved. Cases of true renal varix of the papillae also account for some of these essential hematurias.

Renal hematuria should never be classed as essential or idiopathic unless a most careful exploratory operation with removal of sections from different parts of the kidney (cortex and medulla) has demonstrated the absence of any organic change. Most often, the lesion will be found situated in the medulla or on a papilla. Therefore, unless the kidney is bisected, or the papilla inspected through a large incision in the pelvis, the result of the exploration will always remain in doubt.

Renal hematuria due to such conditions as stone, tuberculosis or hydronephrosis is readily differentiated. The main difficulty is encountered in distinguishing between the so-called essential hematurias and the bleeding due to an early neoplasm of the kidney. Of course, in the more advanced cases, no trouble will be experienced; but with small growths which cannot be palpated, or in tumors involving the pelvis of the kidney, the problem is often a most baffling one. Essential hematuria may simulate an early hypernephroma to such a degree, that the diagnosis can be determined only by an exploratory operation. The finding of albumen and casts in the urine is of considerable diagnostic importance in nephritic hematuria. One should not overlook the fact, however, that nephritis may be associated with other organic renal changes, so that the presence of these elements by no means renders the diagnosis certain. In one of our recent cases, which had been treated in another hospital for over a year for a nephritic hematuria, numerous hyaline and granular casts were found in the urine from the bleeding kidney. This had evidently been of considerable influence in establishing the diagnosis of nephritis. A pyelogram, however, showed changes suggestive of a growth, and at operation, a hypernephroma was found. It is the exception, rather than the rule, to find casts in the urine during the attack of active bleeding. The phenolsulphonephthalein test, urea and blood chemistry, may in the early stages of nephritic hematuria show no marked deviations from the normal.

Whenever feasible, the patient should be cystoscoped during the stage of active bleeding; if examined during an interval it may be impossible to determine its origin, whether renal or vesical, unless distinct meatal changes point to one or the other orifice. The possibility of bleeding from both kidneys should also be borne in mind. Accordingly, it is advisable to cystoscope the patient a few times, for only one side may be bleeding at the time of examination.

The differential diagnosis of these cases requires very careful and painstaking study, at times necessitating weeks of observation with numerous examinations before it will be possible to arrive at a definite conclusion. A careful history is of importance, laying especial stress on any recent infection as a possible predisposing source of the bleeding. The value of a thorough physical examination is recognized by all; enlargement or irregularity in the shape of the kidney, should be carefully noted. The urine should be examined a number of times to determine the presence or absence of casts, and tubercle bacilli. Next in order come the following—laboratory and clinical observations, full blood count, blood chemistry, coagulation time of the blood, blood pressure, Wassermann test, eye-ground examination, and radiography of the urinary tract. Should the patient present himself during the stage of active bleeding, it is advisable to cystoscope immediately, as it then is usually a simple matter to locate the source of the hemorrhage. Otherwise, cystoscopy should be deferred until after the *x*-ray examination. Function tests, preferably using indigo carmine, are often of value, especially when the case is examined after an attack of bleeding. The diseased kidney's function is frequently less than that of the normal one. Cultures from both kidneys should be obtained; followed by the passage of a wax-tipped bougie, to exclude the presence of calculus which may not have been demonstrated in the radiogram. Forcible manipulation of the ureter catheter in the renal pelvis, recently advocated by Beer, with the idea of traumatizing a pelvic growth if one be present, and thus producing hematuria, may occasionally be of value. In two recent instances it was found to be of considerable diagnostic importance. Finally in every doubtful case a pyelogram should be made. Pyelography is probably the most valuable differential procedure at our disposal and may clinch the diagnosis, when all other methods fail. In two instances the diagnosis was made entirely upon the pyelogram.

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Whenever feasible, the patient should be cystoscoped during the stage of active bleeding; if examined during an interval it may be impossible to determine its origin, whether renal or vesical, unless distinct meatal changes point to one or the other orifice. The possibility of bleeding from both kidneys should also be borne in mind. Accordingly, it is advisable to cystoscope the patient a few times, for only one side may be bleeding at the time of examination.

The differential diagnosis of these cases requires very careful and painstaking study, at times necessitating weeks of observation with numerous examinations before it will be possible to arrive at a definite conclusion. A careful history is of importance, laying especial stress on any recent infection as a possible predisposing source of the bleeding. The value of a thorough physical examination is recognized by all; enlargement or irregularity in the shape of the kidney, should be carefully noted. The urine should be examined a number of times to determine the presence or absence of casts, and tubercle bacilli. Next in order come the following—laboratory and clinical observations, full blood count, blood chemistry, coagulation time of the blood, blood pressure, Wassermann test, eye-ground examination, and radiography of the urinary tract. Should the patient present himself during the stage of active bleeding, it is advisable to cystoscope immediately, as it then is usually a simple matter to locate the source of the hemorrhage. Otherwise, cystoscopy should be deferred until after the *x*-ray examination. Function tests, preferably using indigo carmine, are often of value, especially when the case is examined after an attack of bleeding. The diseased kidney's function is frequently less than that of the normal one. Cultures from both kidneys should be obtained; followed by the passage of a wax-tipped bougie, to exclude the presence of calculus which may not have been demonstrated in the radiogram. Forcible manipulation of the ureter catheter in the renal pelvis, recently advocated by Beer, with the idea of traumatizing a pelvic growth if one be present, and thus producing hematuria, may occasionally be of value. In two recent instances it was found to be of considerable diagnostic importance. Finally in every doubtful case a pyelogram should be made. Pyelography is probably the most valuable differential procedure at our disposal and may clinch the diagnosis, when all other methods fail. In two instances the diagnosis was made entirely upon the pyelogram.

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K. B. Male. Age, 30 years. Patient was perfectly well until a few months ago when he developed an attack of scabies, followed by a crop of

furuncles which appeared on the back of the neck. Five days before admission to the hospital, voided bloody urine for first time; accompanied by some frequency, no lumbar pain. The results of various examinations were as follows: General condition, fair, rather anemic, fading scabetic eruption over body, a crop of furuncles on neck. Urine bloody, acid, heavy trace albumen, many pus cells, hyaline and granular casts. Marked pyorrhea alveolares; blood count normal; blood pressure 135/75, *x*-ray and Wasserman reaction negative. Coagulation time seven minutes; blood chemistry shows high nitrogenous retention. Cystoscopy-bladder congested and scattered over its surface are numerous punctuate hemorrhages, with blood-tinged urine observed coming from both kidneys and also obtained by catheterization. No indigo carmine from either side in 30 minutes observation. Cultures from both kidneys sterile, no tubercle bacilli. The bleeding gradually subsided and had entirely ceased within a week. The urinary picture of a nephritis still persists; the blood chemistry remains unchanged.

CASE II—Hematuria due to "Infectious Nephritis."

Male. Age, 38 years. This patient had a severe attack of tonsillitis two weeks before onset of hematuria which began one week ago. Since then the urine has been bloody, accompanied by increased frequency of micturition. Physical examination negative. The urine was bloody microscopically, and showed a heavy trace of albumen, 1026 specific gravity. Cystoscopy demonstrated a bladder studded with numerous hemorrhages and swollen ureteral orifices. Bloody urine was seen issuing from both meati and was also obtained by catheterization. The urea output was low on both sides, 0.8%, and cultures from both kidneys showed staphylococci. Examination for tubercle bacilli, and passage of wax-tipped catheter negative. Pyelograms were not made. The bleeding ceased spontaneously a few days after cystoscopy and has not recurred since. No casts were found at any time.

These two cases may be classified as "infectious nephritis." In both instances there was a distinct history of infection, preceding the hematuria. The bleeding, renal in origin, was associated with multiple bladder hemorrhages. The diagnosis of this type offers no special difficulties and surgical interference is seldom indicated as the bleeding usually ceases spontaneously.

CASE III—Unilateral Renal Hematuria of Unknown Origin.

Male. G. S. Age, 41 years. Admitted to hospital, June 19, 1920, with a six weeks' history of intermittant, painless hematuria. The bleeding had been very profuse, and was never absent more than three to four days at a time. Urinary history negative except for two attacks of gonorrhea. Nine years previously an epithelioma had been removed from the forehead. Besides hematuria, patient complained of weakness and loss of six pounds of weight. The physical examination was negative. The urine was bloody and contained small clots; no casts or pus was found either during the stage of active bleeding or in the interval. Phenolsulphonephthaleia test, 55% in two hours.

Cystoscopic data—The bladder was normal, also the ureteral orifices. Bloody urine was obtained from the left kidney, clear urine from the right. Good indigo carmine concentration from the right kidney, very weak from the left side. The urine from the left kidney showed blood microscopically with normal urea; the urine from the right kidney showed an occasional red blood cell. Cultures of catheterized urines sterile. Wassermann reaction negative, *x*-ray and waxtipped catheter, negative. Pyelogram of left kidney failed to show any changes characteristic of a growth.

On account of the severe nature of the hematuria, and the history of loss of weight, it was considered advisable to explore the left kidney. At operation a normal sized organ was found with a distinct bulge on the posterior aspect. Incision into this area failed to demonstrate any growth. The pelvis was opened through a nephrotomy wound and explored digitally with negative results. There were no evidences of perinephritis. The kidney was decapsulated, and the nephrotomy wound closed without drainage. Within a week, the urine was perfectly clear. A few days later there was another attack of hematuria. This ceased within a few days. More than four months have now elapsed, during which time the patient has remained perfectly well. The pathological report of sections removed from the bulging aspect of the kidney, showed "marked congestion, especially of the glomeruli, with parenchymatous degeneration." The congestion was probably due to the fact that the renal pedicle was terporarily ligated with a rubber ligature to control bleeding during the exploration.

Comment—No definite pathological entity was found, so that this case might be classified as one of essential hematuria. It must be remembered however, that the exploration was not a complete one, insofar as specimens were not removed from the medulla and the pelvis was not visually examined. It is now recognized that most of the changes indicative of infection or nephritis are to be found in the medulla.

CASE IV—Hypernephroma with Metastases in the Renal Pelvis.

L. B. Male. Age, 40 years. This patient was admitted to the hospital July 25, 1920, with a history of attacks of symptomless, intermittant hematuria of one year's duration. He had been treated in another hospital for the preceding year for a nephritic hematuria. The general condition was good, there had been no loss of weight; neither kidney was palpable. The urine on admission was perfectly clear, acid, 1014, with a trace of albumen, and showed a number of hyaline and granular

casts. Radiography negative. Cystoscopy demonstrated a normal bladder and ureteral orifices. Clear urine was obtained from both sides with indigo carmine of equal intensity. The catheterized urines showed epithelium, and red cells in both specimens; urea right, 0.3%; left, 0.5%. Casts were found in the urine from the left kidney, none from the right. Cultures negative. Forcible manipulation of ureter catheters in both pelves produced a severe bleeding from the left kidney which continued for a few days. Wax-tipped bougie negative. Phthalein test, 50%. Coagulation time of blood, 10 minutes. Blood pressure, 130. Eye grounds, normal, blood count normal. Urine negative for tubercle bacilli. The patient was observed for two weeks, during which time there were a few attacks of sharp hematuria. Cystoscopy during these attacks verified the previous findings of a left renal hematuria. A pyelogram of the left kidney showed dilatation and irregularity of the calices. Despite the many clinical findings which seemed to oppose the presence of a growth, it was decided mainly on the pyelographic data to explore the kidney. Operation revealed a hypernephroma confined to the upper pole of the kidney. A large deposit was present in the pelvis, which accounted for the severe hematuria produced by manipulating the catheter. Nephrectomy was done, followed by an uneventful convalescence.

Comments—The history in this instance was of one year's duration. This, with no loss of weight, albumen and casts in the urine, led to a diagnosis of nephritic hematuria. Malignancy was suspected on account of the hemorrhage produced by manipulating the catheter in the pelvis, and the pyelographic picture.

CASE V—Angioma of Renal Pelvis.

Male. Age, 45 years. History of attacks of profuse, painless hematuria, extending over a number of months. Neither kidneys could be palpated. *X*-ray and all other examinations negative. Cystoscopy demonstrated bleeding from the right kidney. Casts were not found in the urine. On account of the profuse nature of the hematuria a tumor was suspected, and it was considered advisable to explore the kidney. At operation a normal-sized kidney was found; the pelvis, however, felt thickened and was dilated. Incision into the pelvis revealed a large angioma which extended into the calices. It was not considered advisable to extirpate the kidney. There was no recurrence of hematuria for two years following this operation. This case would undoubtedly be classified as one of "essential hematuria," had not the exploration revealed a definite organic lesion.

CASE VI—Unilateral Renal Hematuria of Nephritic Origin.

Male. Aged 61 years. Admitted to hospital April, 1920, with a history of four attacks of profuse hematuria, in the past year, at times accompanied by left lumbar pain. No other urinary symptoms, no loss of weight.

Physical examination negative, except that both kidneys could be palpated and the left felt enlarged and irregular. Urine; acid, 1021, red blood cells, occasional white blood cell, no casts, no tubercle bacilli. Radiograms negative.

Cystoscopy—normal bladder, blood seen issuing from left kidney and obtained by catheterization; right specimen normal; urea almost equal on both sides; cultures sterile; wax-tipped bougie negative. Phthalein, 18%. Blood chemistry showed moderate retention. Blood pressure 105/65. Eye grounds, negative. During an interval of bleeding, a few hyaline and granular casts and red blood cells were found. A pyelogram of the left kidney demonstrated dilatation and blunting of calices. and retraction of lower calyx. Despite the presence of a few casts, malignancy of the left kidney was suspected. Exploratory operation demonstrated a small left kidney with a few depressions scattered over the cortex, otherwise nothing abnormal. The kidney was decapsulated and specimens removed from the cortex. Uneventful convalescence. Patient has not had any recurrence of bleeding for the past five months. The sections removed were reported "marked interstitial inflammation with destruction of tubules and atrophy of glomerli."

This case illustrates the difficulties encountered in the differential diagnosis. Whereas the urine pointed to a nephritic condition, the pyelogram was suggestive of malignancy. Despite the negative findings, it is admisable when in doubt to explore, as it is almost impossible to detect early malignancy by any known methods. The value of simple decapsulation in controlling hemorrhage is again exemplified by this case, the second in this series in which this procedure was performed.

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METASTATIC RENAL ABSCESS.

The sudden onset of costo-vertebral pain and tenderness, with fever and chills, associated with the presence of a furuncle or carbuncle or a deep-seated suppurative process in another part of the body, renders the diagnosis almost certain. The onset and course are not as severe, or the general prostration as marked, as in the type described by Brewer, under septic infarcts of the kidney.

The local symptoms will depend upon the location of the abscess. Since they are most frequently situated on the posterior aspect of the kidney, the tenderness and rigidity will be most marked in the lumbar region. In one of our cases, the abscesses were situated on the anterior aspect of the kidney, so that the symptoms were more abdominal than lumbar in character, thus simulating gall-bladder disease.—A. HYMAN in *The Urologic and Cutaneous Review.*

UROLOGY IN WOMEN.

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The genital and urinary organs in women are so often affected coincidentally or the one become diseased as the result of trouble in the other, that a comprehensive view of gynecology cannot omit a consideration of urology.

For a considerable length of time the gynecologist was wont to call upon the urologist for help in diseases of the urinary organs that complicated disorders of the genital tract.

Dr. Howard Kelly was a pioneer in the study of urinary diseases in women and his first work was so accurate and thorough that most of it appears modern today. Since then gynecologists in increasing numbers have devoted more and more attention to urology until today a gynecological service is not considered complete unless one or more of its members is a competent urologist.

Urology in men and in women has many points in common, but there are a few so different that I do not feel that the urologist without gynecological training will ever be as competent as the gynecologist who has interested himself in urology.

In women the urological condition may be simple and confined to the urinary organs; it may be coincident with but devoid of any relation to the gynecological condition; it may be the result of the same factor as the disease of the genitals but not dependent upon it; and, lastly the one may be dependent upon the other.

Urethral stricture in women is a very rare condition, which is in contrast to the prevalence of this trouble in men. On the other hand, chronic urethritis, with or without trigonitis, is the most frequent condition that we find in the diseases of the urinary organs of women. The lesions are usually mild and it is very seldom that they go to stricture formation. In women, the bladder adapts itself so readily to the pressure and distention caused by growths, malpositions and the pregnant uterus that urinary drainage is seldom disturbed. I think that this free drainage accounts for the fact that we seldom have the severe cases of cystitis found in the male, where stricture of the urethra and prostatic enlargement cause the incomplete emptying of the bladder that is so conducive to the more virulent inflammations.

Calculi in the kidney and the ureters appear to be of the same frequency in the two sexes and necessitate the same surgical problems. Vesical calculi are very rare in women, which is to be accounted for on the ground that the drainage is so excellent. Calculi that enter the bladder through the ureter are expelled usually within the first day, so that they are not factors in the formation of large stones. The vesical calculi observed by me have usually had as nuclei, some foreign bodies that have ulcerated into the bladder, such as sponges, silk ligatures, etc., or were inserted through the urethra, as hairpins, etc.

Fortunately, urinary tuberculosis is a simpler affair in the female than in the male as it is exceedingly rare that genital tuberculosis extends to the urinary tract, a happening not so infrequent in the male. In women, urinary tract tuberculosis signifies the affection of at least one kidney, there being no proved case of primary vesical tuberculosis.

From published records it appears that pyelitis and ureteral stricture are infrequent in the male, while the first is quite common in women and the second far from rare. Pyelitis occurs in girls and women of any age, in the pregnant woman, and quite frequently as a post-operative condition. Pyelitis and stricture are often both present and, not until the stricture is properly dilated does the pyelitis disappear.

A great many men are still skeptical about the occurrence of stricture of the ureter. A demonstration of obstruction to the passage of a ureteral catheter; the hang that is noticed when an attempt is made to withdraw an olive bulb that has passed beyond the stricture; the ureterographic demonstration of a dilated ureter with a point of narrowing below; and relief of symptoms by stretching the stricture, should be sufficient proof of the occurrence of this condition.

Most ureteral strictures are discovered after a patient has been operated upon erroneously for some other condition. As a rule the attacks of pain from ureteral stricture are intermittent, coming on first at long intervals in moderate severity, with gradually decreasing intervals and increasing severity. Just why they should be so infrequent in the male and relatively common in the female, I am at a loss to understand.

The injuries of the bladder, urethra and ureters form an interesting chapter. In the days of poor obstetrics injuries to the bladder and urethra were more common. Now, with better obstetrics, the number is considerably lessened. Formerly, operative injuries of the bladder and urethra were infrequent, but since the gynecologist has become more radical in his operations—especially in the extensive operation for cervical and uterine carcinoma, mishaps to the bladder and ureters, especially to the latter, are more frequent.

The relaxed urethra following difficult labor is relatively frequent. This may manifest itself in degrees varying from the loss of small amounts of urine on severe exertion, to absolute incontinence, even in the recumbent position. Fortunately, it is only the minor grades that are commonly seen, but every few years a few of the more extensive injuries come under observation. This condition is best appreciated and diagnosed by the lack of resistance to the passage of instruments through the urethra, and the failure of the urethral sphincter to properly close over the end of the Gerringer or Kelly cystoscope as it is drawn from the urethra.

In the ureteral injuries we have to determine which ureter is injured; the distance of the injury from the bladder; whether it is a side wall injury; the presence or absence of an infection; the relative and combined function of the kidneys; and whether or not the accompanying pelvic condition will allow of the performance of an operation that will restore the flow of urine to the bladder.

In the cases of new growths in the bladder, I believe that papillomata are as frequent in the female as in the male, but that the infiltrating carcinomata are rarer. The type of carcinoma which the gynecologist most often sees is that which has extended from a cervical growth. Often this extension occurs before vesical symptoms or the appearance of the cervix and vagina arouse suspicion. The practice in all gynecological clinics is to make a cystoscopic examination in every case of uterine carcinoma, so that such extension may be known and deter us from too radical a procedure.

THE AMERICAN JOURNAL OF OBSTETRICS AND GYNECOLOGY.

Within the past year the *American Journal of Obstetrics and Diseases of Women and Children*, established in 1868 and published by Wm. Wood Company of New York, ceased existence after a long and honorable career. As a successor to this journal there has now entered the field the *American Journal of Obstetrics and Gynecology*, of which the first issue appeared in October, 1920. It is published monthly by the C. V. Mosby Company of St. Louis, under the auspices of the American Gynecological Society, the American Association of Obstetricians and Gynecologists, and the Obstetrical Societies of New York, Philadelphia and Brooklyn. The editor is Dr. George W. Kosmak, New York, who was editor of the older journal. Dr. Hugo Ehrenfest, St. Louis, is associate editor, and there is a large editorial board of prominent American gynecologists and obstetricians.

FURTHER OBSERVATIONS ON GENITAL TUBERCULOSIS IN THE MALE.

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In various publications (*Am. Jour. Urol.*, 1911; *Boston Med. & Surg. Jour.*, CLXVIII, 1913; *Ibid.*, CLXVI, 1912; *Jour. of the A. M. A.*, Dec. 31, 1914; *Ibid.*, LXI, 1913) the writer came to certain definite general conclusions in regard to tuberculosis of the male genital tract. Further observation over a considerable period of years of cases both before and after operation has wrought but little change in these views. Among other conclusions the following seem to be of importance:

1. The epididymis is the primary focus in the genital tract, but

2. This is always secondary to a focus elsewhere in the body, this focus being situated most often in the lung.

3. The prostate and seminal vesicles are invaded by the disease early and often, but after removal of the epididymis clinical cure is finally established.

4. The second epididymis becomes involved in at least half the cases, but involvement of this organ may be obviated by early resection of its vas deferens.

5. Orchidectomy is unnecessary if the testicle is free from disease, and even if affected the diseased portion can be successfully removed in many instances. Even a portion of one or both testicles is worth saving, both on account of the internal secretion and the mental effect upon the patient. After castration the sexual function may be unimpaired.

The question as to whether the primary focus in the genital tract lies in the prostate or epididymis is still under discussion. The result of my investigations, especially those involving end-results, would appear to settle the question in favor of the latter organ.

Primary tuberculosis of the prostate is generally acknowledged to be a distinct rarety, either clinically or post-mortem. A few cases have been reported; some are undoubtedly genuine, but a shroud of suspicion clings to most. If epididymal tuberculosis, which is not uncommon, is always secondary to a lesion in the prostate it would be reasonable to suppose that early cases with the prostate above involved, would be encountered in greater abundance. Neither I nor my colleagues at the hospital have ever discovered a case of primary prostatic tuberculosis in a search extending

over several years in a large genito-urinary clinic.

Tuberculosis of the genital tract is very uncommon in children. In the few cases which I have seen there has been no demonstrable involvement of the prostate or seminal vesicles. The reason for this doubtless lies in the fact that these organs are but rudimentary before the age of puberty. If these organs are too little developed to acquire a secondary infection are they not equally incapable of acting as a primary source of the disease? Certainly clinical experience bears out this belief.

Continued observation still enables me to state that the prostate and vesicles, extensively indurated and definitely tuberculous before operation, eventually return to a condition of clinical cure after the removal of the epididymis. The nodularity and induration subside, the bladder irritability ceases, and a urine which was definitely pathological, even at times containing tubercle bacilli, becomes normal. These changes are slow and restoration to normal both subjectively and objectively is not always complete. But the very fact of such changes forces me to believe that the starting point of the disease lies in the epididymis, as otherwise how would the removal of this secondary focus influence a primary focus in the prostate?

Doubtless those who favor the prostate will argue very plausibly that the primary infection of this organ readily explains the occurrence of tuberculosis in so many epididymes on the second side. They entirely overlook the fact that the experience of many observers has shown that the second epididymis becomes involved far less often after removal of the first epididymis than when no operation at all is done. In other words this fact fits in with the observation already made that subsidence of the disease in the prostate is to be expected after excision of a tuberculous epididymis. In the presence of a subsiding process it is unlikely that there would be enough activity to extend to the opposite side. Moreover I pointed out some years ago that the vas of the side last involved is less often and less extensively infected than is its fellow, a fact which would suggest that the tubercle bacillus reached the second side by the blood stream or through the lymphatics. In favor of this view I may mention a case recently seen in which I performed unilateral epididymo-vasectomy ten years ago. The patient has been seen from time to time ever since. The testicle of the side first involved has remained normal in size and consistency, there was no sinus, the prostate has become smaller, less indurated and nodular, and the vesicle on the affected side, formerly indurated and enlarged, has subsided to a practically normal condition. The patient's general condition has been excellent. About a month ago he returned with tuberculosis of the second epididymis. The corresponding seminal vesicle and lateral lobe of the prostate were indurated and enlarged. At operation not only the epididymis but the testicle as well was found to be extensively involved and orchidectomy was done. Radiography of the chest showed a mass of calcified glands about the lung roots. It may be argued by those who favor the prostate that this organ being the primary focus gave rise to the second epididymitis. This ground would appear to be untenable, inasmuch as the prostate had become virtually normal and there were no bladder symptoms to suggest its disease. It is my opinion that the second epididymis became infected by way of the blood stream as did its mate, the primary focus being meantime in the lung.

The diagnosis of tuberculosis of the epididymis is often difficult, especially in the presence of a gonococcal prostatitis. It is well to remember, however, that tuberculosis may invade the epididymis during an attack of gonorrhea. A chronic or subacute epididymitis may be due to the tubercle bacillus, the gonococcus, the colon bacillus or to pyogenic cocci. Only very careful consideration of every point of both subjective and objective symptoms and repeated observations will enable a differential diagnosis to be made. As a moderate degree of hydrocele is often present I believe it is worthwhile to tap the tunical sac and withdraw this fluid. In one case, seen some years ago at the hospital, none of us was able to make a definite diagnosis. Finally the hydrocele fluid was examined and many tubercle bacilli found in the sediment. I was much encouraged by this and have since examined the fluid in a number of cases but without success.

Where a sinus, active or healed, is found in the scrotum I believe that the diagnosis of tuberculosis is certain. No process of which I am aware, other than tuberculosis, goes on to abscess formation with spontaneous rupture and the establishment of a sinus.

In the presence of obvious disease of the epididymis which does not yield to palliative measures in a reasonable time I am of the opinion that the patient should be given the benefit of the doubt and operation advised. This need be but an exploratory procedure under local anesthesia, with removal of a section of tissue for microscopic examination. Two cases which have come under my observation have impressed upon me the wisdom of this procedure.

One case was that of a man of 33 who had been

regarded as phthisical for years, although the tubercle bacillus had never been found in his sputum. He was wealthy and had been able to live under the best of conditions. I was asked to see him in consultation with his doctor, an able surgeon, who thought the patient had a tuberculous epididymis. While it was not a clean-cut case of that disease I agreed with the surgeon and advised operation. This was refused by the surgeon, who, as an alternative, sent the patient to the Adirondacks and had tuberculin given. Under this regime the patient's general condition improved considerably, but the process in the scrotum increased in size, and finally an orchidectomy was performed. Examination of the specimen showed sarcoma of the testicle, there being no trace of tuberculosis. The patient died of metastasis about three years later.

The second case was that of a man of 20 who was tall and thin, and who had outgrown his strength. He had consulted a well-known urologist for a painful swelling of the scrotum following an attack of measles. The urologist made a diagnosis of tuberculous epididymitis and adopted the *laissez faire* policy. I was asked to see the case, concurred in the diagnosis of tuberculosis, especially in view of the fact that an appendicectomy done meanwhile had shown a number of enlarged mesenteric glands which were thought to be tubercular, and advised epididymectomy. Finally after some months of palliation, without appreciable effect upon the condition in the scrotum, the patient consulted a third surgeon who advised and performed orchidectomy. Here also examination of the specimen revealed sarcoma of the testicle. The operation was performed about a year ago and the patient is still alive and well, but the history of such tumors does not argue well for the boy's future.

I was wrong in my diagnosis in both these cases, but I was certainly on the safe side in advising operation. The diagnosis of scrotal tumors is notably uncertain and I firmly believe that unless one is perfectly sure of their nature, and this is impossible without microscopic examination, or unless the condition improves under expectant treatment, the mass should be explored and probably removed. Incidentally these two cases are of interest in that the disease was seen at an early stage in both, and in each the swelling involved chiefly the epididymis.

One occasionally sees a patient whose disease is far advanced, with not only renal tuberculosis but an active process in the lung as well. These cases are probably better off without operation, as after all the epididymal process is but a small matter compared with the kidney lesion, and the patient is in no condition to stand nephrectomy. The best of hygienic surroundings, preferably in a first-class sanatorium, together with tuberculin, will tend to reduce the activity of the disease and improve the patient's general condition. Other than this the patient's comfort is about all that one can hope to improve.

The presence of tubercle bacilli in the urine of many of these patients, especially those with renal tuberculosis, should be taken more seriously. These organisms are quite as active as those in the sputum and therefore capable of infecting others. Patients should be instructed in the care of their hands, bed clothing, underwear, urinals, etc., as is the case in lung tuberculosis.

I believe that epididymo-vasectomy is the treatment of choice in these cases. In an early investigation I found that this operation had an operative mortality of 2.66% in 150 cases, there being 4 deaths, all of general miliary tuberculosis. Ether was given in each instance and I believe is responsible for the mortality by its irritating effect upon an active process in the lungs. I have recently had occasion to study a series of 103 patients bearing 114 tuberculous epididymes, seen during the past eight years in the genito-urinary service at the Massachusetts General Hospital. Epididymo-vasectomy, bilateral in 26, unilateral in 56, was done on 97 patients with no deaths. Orchidectomy was necessary in only 6 cases. Ether was given only 23 times, mostly in the early years; the more recent cases had local anesthesia (novocain) 38 times, and spinal (novocaine) anesthesia 10 times. I am now using local anesthesia in practically every case and hear no complaint from the patient during the operation. There can be no doubt that surgical judgment of today must consider the choice of the best anesthetic for a particular case, just as it also involves the question of operability or the type of operation to be performed.

In the belief that the technic of operation which we are performing on these patients, and which was described by Dr. Hugh Cabot and myself some years ago (*Journal of the A. M. A.*, 1913, LXI) should be more widely known I quote its description.

"An incision is made over the epididymis about two inches long. If sinuses are present they should be circumscribed by the incision. This is carried down to and opens the tunica vaginalis, which will in many cases be found adherent to the testicle and must be separated by dissection. The testicle and epididymis are delivered from the wound. The

epididymis is then separated from the testicle by a scissors dissection, as in this way the vessels which lie behind the epididymis are less likely to be destroyed. The separation should be begun at the upper pole and carried downward, the epididymis being separated from within outward. When it is free the lower inch or two of the vas should be stripped up by blunt dissection from the structures of the cord. A curved clamp is then applied to the vas and the epididymis and the lower inch or two of the vas cut away. The vas is then stripped up by blunt dissection with the fingers so as to free it from the structures of the cord up to the external inguinal ring. Guided by the finger, the clamp on the lower end of the vas is then passed up to the external ring and carefully inserted into the canal, care being taken to avoid pushing it in front of the canal between the fascia and the fat. The clamp is then pushed upward and outward, following the line of the inguinal canal until its tip lies directly beneath the fascia at the level of the internal inguinal ring. The handle of the clamp is then strongly depressed, bringing the point snugly against the skin. An incision not over half an inch in length is then made on the point of the clamp, which is then pushed out through this incision carrying with it the distal end of the vas. The vas is then picked up, the traction is made so as to pull out the portion lying in the canal so that the remaining portion dives vertically into the wound and over the brim of the pelvis. The finger is then inserted into the little wound, and the vas is freed as far as the finger can reach, making steady traction during this process. A right-angled clamp is then applied to the vas at the lowest accessible point. It is divided, cauterized with phenol (carbolic acid) and dropped back. The wound in the groin is closed with one catgut suture in the fascia, with a silkworm-gut stitch in the skin. The operation is completed by the careful ligation of any bleeding-points in the scrotum. Any apparent foci in the testicle are eradicated with a curette. The wound is painted with tincture of iodin and closed with a subcuticular suture of silkworm gut, leaving a small protective-tissue drain at the lower angle. This drain has been found to shorten convalescence by giving free exit to the serum which necessarily oozes from the raw surface, the amount of which is considerably increased by the application of iodin. The dressing is held in place by the application of an Alexander bandage, one of the many devices of the late Samuel Alexander, which has been a boon to the genito-urinary surgeon. The drain can generally be removed in forty-eight hours and the patient may be up and about in two or three days."

I have already remarked that orchidectomy was necessary in only six of the series just cited. In a few of the epididymo-vasectomies partial orchidectomy was performed on one or both sides. In these cases it is obvious that at least microscopic tuberculosis was left in the testicle, yet this organ overcame this handicap in every instance and no case of secondary orchidectomy has had to be done.

Orchidectomy is occasionally necessary even though the testicle is but little or not at all affected. I refer to those cases wherein there is a massive tuberculous infiltration, not only of the vas but of the whole spermatic cord as well. The tuberculous deposit is so interspersed among the vessels of the cord that its removal necessitates destroying the blood supply. But even this amount of tuberculosis may at times be left undisturbed as has been demonstrated by a patient in whom this condition obtained and upon whom I operated last August removing only the epididymis and vas deferens. The patient was willing to take the chance of a second operation being necessary, but up to date the process has shown no evidence of development; on the other hand the cord is less indurated and thickened at the time of operation and behaves as if it it would eventually quiet down.

None of our patients is known to have had a persistent or even a temporary sinus from the stump of the vas where epididymo-vasectomy was done, by the method described, a point which is in striking contrast to the operation of earlier days when the vas was cut off at or near the external inguinal ring, and in some cases was actually sutured to the skin for its better drainage. Needless to say this drainage maintained itself in the form of a sinus for weeks, months and sometimes years. By amputating the vas well beyond the internal inguinal ring the section is made at a point where there is the smallest amount of tuberculous disease and the stump is deeply buried.

Radical operations involving the removal of the prostate and vesicles, as well as of the testes, vasa and epididymes were advocated and practiced many years ago by different European surgeons. Whiteside, and more recently Quinby and Young in this country, have carried out these radical measures in the belief not only that the primary focus lay in the prostate, but that better results were to be looked for. While due credit must be given them for their skill I feel that the operation which they advocate is unnecessarily mutilating and that after all is said and done the ultimate results are no bet-

ter than those obtained by more conservative surgery. No operation will remove all traces of the disease, and an old process in the lung lurks constantly in the background to break into renewed activity after a quiescence of many years.

In closing I wish to state that all patients, both hospital and private, should be carefully and frequently scrutinized by an efficient follow-up system. Each patient is urged to return not only for tuberculin but also for observation. For many years my colleague, Dr. John B. Hawes, 2nd, has carried on a most successful tuberculin clinic at the Massachusetts General Hospital. Patients with surgical and urological tuberculosis report there once a week. The temperature, pulse and weight are regularly recorded and the local and general condition are gone over. The dose of tuberculin is carefully graded for each patient, increased slowly at each visit until the maximum dose is reached, and continued until objective and subjective symptoms have improved or disappeared, this process taking weeks or months. My own observations of this post-operative treatment of the urological cases convince me that although tuberculin is but a factor it is of enormous help when combined with other hygienic measures in which the patients are instructed at each visit. While the use of tuberculin must be well understood and its possibilities for untoward effects realized it can be employed with comparative safety by the average physician.

REBELLIOUS SUPPURATIVE CYSTITIS. TREATMENT BY CONTINUOUS HOT IRRIGATION.

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NEWARK, N. J.

The more general recognition of cystitis as a morbid entity due to infection of tissues reduced in resistance by some other cause, the infecting agency being of a progredient nature either from above or below or of hematogenous origin, has enormously improved the prognostics of this ailment, but the rather dogmatic position which this assertion has acquired and the consequent impression that once the cause is discovered and removed, the cystitis will clear without much more trouble, is being shaken by further observation and experience. This statement has no reference to such conditions as Hunner's ulcer but to those of the chronically suppurating type. The bladder which in the beginning suffered from the other organs, now, in consequence of serious interstitial changes and deep infection of its substance menaces the other organs as a distributing focus of infection and threatens the somatic integrity of the patient by severe suffering and septic toxemia. The dictum of Bazy that a prominent feature distinguishing cystitis from lesions of the upper urinary tract, is the preservation of general health, must not be allowed to expand into a belief of the benignity of vesical suppurations as Brewer has demonstrated the dangers of metastatic accidents to the kidney from local suppurations, especially of the lower urinary passages. Recent animal experiments of Eisendrath and Kahn appear to confirm the claims of Sampson and Bauereisen that the lymphatic capillaries of the bladder and ureter are very active in the matter of distributing infection to the kidneys and perinephric tissues. The infected vesical tissues may easily act as reciprocal infectors.

Most cystitides, it is true, will clear up after removal of a diseased kidney or calculus, prostatic or urethral obstruction, suppurating seminal vesicle, prostatic calculus or abscess, but in spite of well-considered treatment there is a goodly number of vesical suppurations going about notwithstanding that the primary and proximate causes have been removed. In other words the cystitis has become the main pathological entity. Why? Because the three predisposing factors of trauma, congestion and urinary retention or a combination of any or all of them substantially continue in operation. We are not speaking of pyelitis or concealed stone masking symptomatically as cystitis. Vesical inflammation of long standing leads to textural changes in the mucus and muscular coats of which thickening and ulceration, more or less deep, and muscular atony and atrophy, more or less extensive, are the usual consequences. We have here the explanation of the pain and urinary urgency and also of the atony so often encountered in rebellious cases of suppurative cystitis.

The most important elements in the treatment of purulent cystitis are to keep the bladder continuously clean and to improve the nutrition of the local tissues. The vesical membrane being more or less ulcerated and covered with firmly adherent muco-purulent masses, often incrustations, the futility of irrigations, as ordinarily administered, becomes evident. Such bladders are therefore cauterized with solid silver nitrate, fulgurated and burned with the actual cautery "practically through the whole thickness of the bladder wall," but very few are cured because such efforts are circumscribed and, after all, the ulcer merely represents one of the consequences of, but not the whole disease.

In 1896, a man about 41 years old came into my service at the Alexian Brother's Hospital of Elizabeth, N. J., for observation and possible relief from severe urinary tenesmus, pyuria and failing health. He had had undergone a cystotomy eight years before on account of stone and cystitis, followed by a long period of irrigations with various substances, but no decided improvement. Two years later perineal section and drainage with more irrigations but only temporary relief. Had lost sixty pounds and was getting weaker all the time. He was in wretched condition, evidently slowly dying of exhaustion from pain and sepsis. While I was making up my mind what to do with this man I became convinced that irrigations as ordinarily given amounted, therapeutically to simple instillations of mild antiseptics, good enough for mild inflammations but wholly unable to meet the requirements of severe and obstinate cases. The patient's urethra had become so intolerant that he declined any treatment through that channel. It was decided to do a suprapubic cystotomy, put in a delivery tube, also a perineal section and insert a drainage tube into the bladder, then connect the feeding tube with the hot water supply and run a continuous stream of sterile water through the bladder at the maximum temperature and maximum pressure the patient would be able to stand with perfect comfort. An ingenious member of the nursing staff constructed a pipe with coil and cooler, there being a two-way cock between the coil and the patient. By this method it was thought that we should supply the therapeutic indications of hydrostatic attrition for the purpose of removing adherent secretions not only from the vesical surface but likewise from beneath folds and diverticles, effect thoroughly the mechanical removal of bacteria, secure the well-known soothing action of heat on the painful bladder and stimulate cellular metabolism and local phagocytosis through the alterative and roborant effect of moist heat, in order to permit of regeneration of a serviceable viscus. Relief of pain was striking. Irrigation was continued without interruption day and night for three months. The patient recovered and when last seen five years after his discharge from the institution, he was symptom-free. The urine showing merely a slight excess of mucus and an occasional leucocyte. The streptococcus could not be found any more.

This method is intended as an extraordinary measure for rebellious cases only; on the other hand, it is neither dangerous nor difficult. It is certainly free from such punishment as is inflicted by the nitrate stick or cautery, besides being a remedy that treats the whole disease. It may be used whenever the patient's condition gives the least hope, as the inlet tube can be inserted under local anesthesia through the canula after suprapubic puncture according to the method of Belfield. In most patients the urethra will tolerate a retention catheter so that the washwater can be carried off in that way. The main points are a continuous flow of sterile water as hot as the patient can comfortably bear (90°-110° F.) under sufficient pressure to thoroughly flush the viscus without overdistention, for anywhere from eight to twelve weeks. The tubes are then removed and the urine carefully watched. If necessary the tubes can be reinserted for an additional course.

The thickened and painful bladder remaining after healed tuberculosis will tolerate only the slightest distention but does well on a higher temperature of the water than the other types of purulent cystitis. This method is also effective in rebellious pyelitis when a stubborn bladder infection is preventing the renal disease from clearing. Marion has used cold water in this way after prostatectomy for the purpose of preventing hemorrhage and sepsis. He claims to have been successful in every case so treated. For the writer the presence or strong suspicion of vesical infection in bladder casualties has always been an indication for continuous irrigation for several days until the danger of sepsis seemed averted. The irrigation should, however, not be made under much pressure because of the likelihood of reopening the vesical rent. When there happens to be concomitant spinal injury the drain tube should be inserted through a perineal opening, because in such cases there is very apt to be urethral sloughing from a retention catheter in the urethra. In his recent Hunterian lecture, Walker states that he also has employed continuous irrigation for a few days with excellent results, in his gunshot bladder casualties.

This method will not cure everyone but the practitioner who applies it with judgment will surely find a larger number of cases of rebellious suppurative cystitis restored to functional integrity.

TRAUMATIC ORCHITIS.

Speaking in a general way, contusion of the testicle presents three degrees, namely, interstitial blood suffusions, hematoma of the testicle, and rupture of the albuginea with hernia of the seminiferous tubules. To effect the latter lesion a pressure of fifty kilograms is required. A certain degree of contusion of the scrotal integuments always exists but suppuration is rare.—*Medical Record.*

RADIUM THERAPY OF CANCER OF BLADDER AND PROSTATE.

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The urinary bladder offers a field of predilection for radiotherapy because the knife is pretty well discredited as a means of dealing with malignancy of bladder and prostate and because the palliative and curative potentialities of radioactive substances while admittedly existent do not imply any primary mortality or the enormous suffering following relapses after cutting operations.

Since experiences in radiotherapy have accumulated and have been sifted it is now possible to avoid the infliction of damage and to select time and methods of application, that will ensure the greatest possible advantages. While it is true that the character of the tumor is the most essential feature in furnishing or denying therapeutic success, still it seems that the time and mode of application and the calling in of preparatory and additional measures are apt to influence the results obtained. It is known at the present time that in any object that is exposed to rays another system or complex of secondary rays is set up—the character of these secondary rays depending not only upon the nature of the primary source of the rays but also upon the material that is interposed between the source of the rays and the object to be rayed, in other words it depends on the filter employed in order to ward off the soft rays and permitting only the hard ones to reach the organ or tumor in question. This fact explains that in some instances even at a remote date changes may occur produced by secondary rays also in organs quite distant from the tumor that was meant to be treated by rays. Heavy zinc and lead filters have proven to be particularly prone to produce such untoward results, among which perforation of a bowel may be quoted as one of the most dangerous accidents.

Gold seems to be the best material for radium filters in bladder work and that for two reasons: On account of the high atomic weight of this metal the filtering capsule does not have to be very thick, which permits easy introduction through the natural channels, and in eight years of experience we never had occasion to notice any remote or long distance damaging of pelvic or abdominal organs.

As to the time of radium application we distinguish between primary application, raying following electrocoagulation of the tumor, and prophylatic raying secondary to the excision of the growth. The time of the primary introduction of radium into the bladder will depend on the condition of the viscus. If there is no appreciable cystitis the radium may be inserted without any preparatory steps. But if pronounced cystitic changes are present, it is of great advantage to submit the bladder to some preliminary treatment. Two benefits are obtained in this way; the inconvenience caused to the patient by the insertion of radium is reduced to a minimum and the control of the action of the radium is facilitated.

An inflamed bladder is rather intolerant toward the introduction of a foreign body and the suffering of the patient is unnecessarily increased by such an interference. On the other hand, the radium will always produce a certain reaction inside of the viscus—if the cystitis is not cleared up previously to the insertion of the radium, it will be very hard to decide how much of the irritation and subsequent changes in the mucosa have to be blamed on the cystitis and how much on the radium.

If we have to deal with ammoniacal cystitis, we will attempt to acidify the urine by giving some mineral acid per os, at the same time trying to quickly improve the local condition. In this category of cases the instillation of small quantities of pyoktanin solution, 1-5000, gives good results. As soon as the urine is deodorized instillations of iodoform-oil emulsion, ten per cent., are employed. In other cases of cystitis we start right away with the iodoform administration, which not only will help in ameliorating the local condition but also acts as an excellent anodyne. The radium therapy is started as soon as the cystitis is cleared up.

In cases in which frequent and copious hemorrhages prevail it will prove to advantage to irrigate the bladder several times with a 1-000 silver nitrate solution, until the urine clears up.

Tumor cases that are accompanied by infiltrating cystitis of such a degree that the bladder is unable to retain even very small quantities of urine are not proper objects for primary radium application.

Such bladders are opened by the suprapubic route which procedure answers two demands. The annoying strangury is relieved and at the same time the tumor or tumors are made easily accessible for the treatment preparatory to the application of radium. This preparatory treatment consists in electrocoagulation of the accessible parts of the growths. The surgical diathermy immediately does away with hemorrhage and pain and furnishes incidentally another advantage—the stimulation of a malignant tumor occasionally observed under

raying never occurs in instances of electrocoagulation previously accomplished.

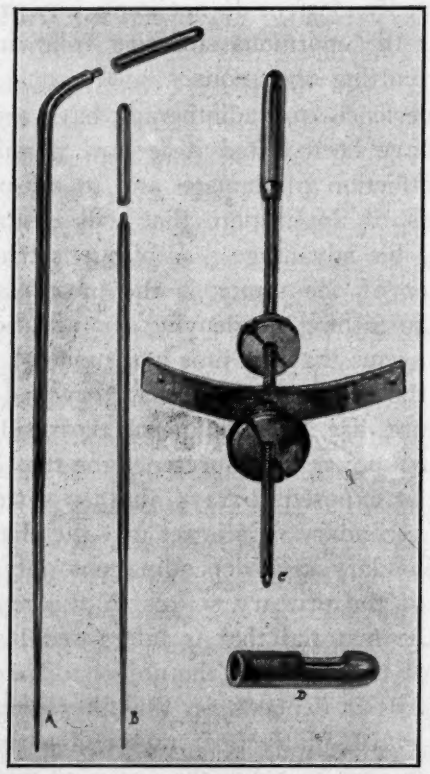
The radium treatment may follow immediately the coagulation of the growth; in fact the radium rays seems to enhance and accelerate the detachment of the eschar produced by the diathermy.

Prophylactic treatment after the excision of tumors of the bladder is started as soon as the first wound reaction has subsided. The application of radium to prostatic cancers is conducted on the same principles. It may be mentioned in addition that prostatic cancers causing pronounced pains due to the capsular tension, that are not promptly relieved by radium, call for suprapubic opening of the bladder and electrocoagulation of the prostatic tumor.

The technique of the radium application depends principally on the question whether the bladder is open at the time of the intended radiotherapy or whether it is desired to insert the radium through the natural channels. All the cystoscopic appliances devised for the purpose of placing the radium container on certain spots and keeping it there are not only unnecessary and lead to torturing the patient with bulky instruments, but will always fail in their purpose.

If a tumor is amenable at all to radium treatment, it will respond by involution even if only one part of it is exposed to the therapeutic rays—this empiric knowledge is supported by theoretical reasoning: it becomes more and more probable that the curative success of radiotherapy is based on the production of defensive and protective ferments and not on any direct destructive action of the rays on the tumor cells. It is furthermore impossible to keep any foreign body close to and in permanent contact with any spot inside of a closed bladder. The apposition of a foreign body will always excite in a shorter or longer time partial contractions of the bladder wall so that it will crawl from under any such pressing object. The truth of this statement may be verified by cystoscopic and fluoroscopic observation.

For the placing of radium or similar substances into the unopened bladder we use silver sounds the tip of which consists of a detachable hollow gold tip of 3-millimeter thickness into which the glass container carrying the radioactive substance is placed. This sound has a caliber of 21 Charrière. In order to prevent pressing of the bed-covers on the handle of the sound the lower part of the patient's body is protected by a crate. In practically all the cases any artificial fastening of the sound will be unnecessary; the majority of patients are very tolerant toward this sound, and only in very sensitive individuals will the administration of a morphine suppository (rectal) be necessary. The patients either urinate spontaneously alongside the shaft of the sound, or if they are unable to do so, the sound is removed at regular intervals to permit micturition. Frequent urination is encouraged to keep the bladder contracted. This, together with the fact that the irridation of radium through a gold container will always extend to at least four centimeters distance, will always ensure that at least one



A, Sound for Males; B, Sound for Females; C, Carrier with Adjustable Crossbar; D, Fenestrated Lead Cap.

part of the tumor is under the influence of the therapeutic rays. If the bladder was opened previously to the radium application the container and filtering capsule are dropped into the bladder through the suprapubic opening. A string or chain is attached to the capsule and fastened to the abdominal skin, so as to permit prompt removal.

If no gold filter is available the capsule before application must be wrapped up in a cover of pure rubber in order to prevent secondary surface irradiation, that may produce very disagreeable burns. We leave the radium container for 24 hours in the bladder and repeat the sittings once every week, utilizing the intervals for antiseptic treatments of the viscus. If for some reason it is deemed advisable to apply to a prostatic tumor the radium per rectum special precautions have to be

taken, because the rectal mucosa is very susceptible to the destructive influence of radium rays.

In addition to the filter the mucous membrane has to be protected in such a way that even the gamma rays will hit only this area that corresponds with the prostatic surface facing the anterior rectal wall. For this purpose a heavy lead cup is slipped over the filtering capsule. In this cap a little fenestra is cut; the container is then placed into the rectum in such a way that this opening lies against the prostate, while the balance of the rectal ampulla is entirely screened off. In order to maintain the capsule in this position it is connected with a stiff rod that carries a curved crossbar. This crossbar is adjustable. After proper placing of the capsule the crossbar is made to fit into the anal rim, in which position it is fastened by tape or adhesive strips.

From our experience we feel justified in stating, that the injection of proteids into the prostatic tissue seems to enhance the radium action in a decisive way. We use for this purpose proteus enzyme prepared after Kendall's method.

In a general way it may be said that if a few radium treatments do not produce decided improvement continuance is hopeless and we have to resort to electrocoagulation.

The first sign of damage done to the vesical mucosa by radium is the appearance of multiple small blisters, and extreme irritability of the bladder is perceived by the patient.

An amount of fifty milligrammes of radium or mesothorium is sufficient for the application to vesical or prostatic tumors. The formerly cherished supposition that very large quantities of radium will accomplish what reasonably large quantities could not achieve is more and more relinquished by radium therapists. Experience has led also to the abolishment by a good many of tunneling or needling tumors with the view to multiple insertion of radium. The results are not any more favorable while the suffering of the patient is increased and the danger of superseding infection is invoked by these methods.

CHANCROIDS.

In cases of multiple chancroids on a long prepuce where rest in bed cannot be insisted on, and in cases of chancroids beneath a tight prepuce where a dorsal or bilateral incision is indicated, complete circumcision will follow with no bad results and it will probably shorten the time required for treatment by the conservative method.—SAMUEL NEWMAN in the *Virginia Medical Monthly*.

FURTHER PROGRESS IN THE TREATMENT OF TUMORS OF THE FEMALE BLADDER.

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No more distressing condition, from the patient's standpoint, is met with than tumor of the female bladder, and no other condition offers greater difficulties from the standpoint of effective treatment. This condition is met in all periods of life, but as is the case with all other tumors, is more common after middle age. The course is prolonged, the tendency is for the condition to remain confined to the bladder, and it may continue benign for years. Approximately one-half of these tumors are malignant, and the majority of the others become malignant at a later period. These tumors exist in two common types: coarse, or fine villous growths with a narrow pedicle; or flat and lobulated with a broad, sessile base.

The question of diagnosis is usually not difficult. Any patient with a history of bladder irritation and hematuria should be examined with the cystoscope. For this we are using the Kelly open aërocystoscope with the patient in the knee-chest position. This presents incontestable advantages for seeing these tumors in their actual state and in determining their number, position, and relation. A characteristic and definite clipping can be easily taken from the base of the tumor, under direct sight, for microscopic study. The benign growths cannot be palpated on bimanual examination as there is no existing underlying induration, but broad, flat, sessile tumors can be felt, and are in every case malignant. All patients with hematuria should be cystoscoped with this condition in mind. Neglect to do this has allowed many a small and easily treated papilloma to develop from a benign to a malignant one, and a comparatively simple condition to reach a most serious proportion, with the case desperate, and the treatment extremely difficult, and unfortunately less effective.

The etiology of this condition, as is true of new growths situated elsewhere, is not definitely established. Some observers contend that in a large percentage of cases there is a history of chronic cystitis, or stone, or some form of long-standing bladder irritation. In our series we have found this element negligible.

The first great step forward in the treatment of this perplexing situation was brought about by the pioneer work of Edwin Beer. Fulguration has become by common consent the method of choice for

all cases in which it can be applied. There is still a small group of cases which we are inclined to reserve for open surgery. This refers to the huge massive tumors which almost completely fill the bladder. The routine surgical removal, which at its best is a most dangerous and difficult procedure, is attended by a most distressing number of recurrences, estimated as high as 75%. Complete cystectomy is discouraging as there is a very high im-

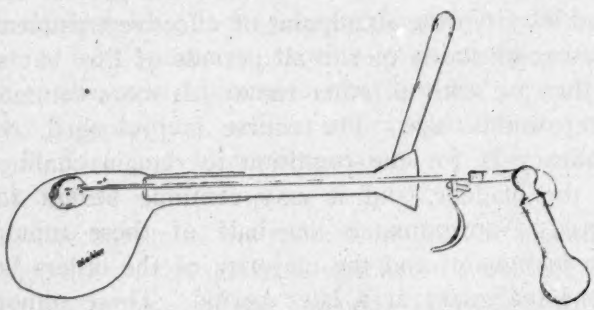

Fig. 1—Radium emanation in glass capillary tube; (a) implanted into tumor and left permanently; (b) left ureteral orifice.

mediate mortality and the end-result is not favorable, Gardner (Trans. *Am. Urol. Assn.*, IX, 226, 1915), reports 96 cases of benign papillomata removed by excision with recurrence in 36%, while in 61 cases treated by fulguration alone there was recurrence in 13%.

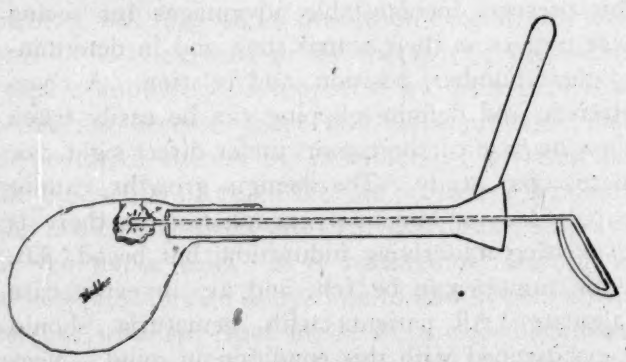

Fig. 2—Radium emanation encased in a brass capsule; (a) attached to sound and held against the tumor under direct vision, through a No. X Kelly cystoscope.

Our method of treatment during the past five years has drawn us further and further away from any operative procedure, except in the cases of massive tumors. The treatments can be given with great ease and accuracy through the Kelly cystoscope. Our best results have been obtained by the use of radium. The flat tumors with broad sessile bases are treated by implanting (or shooting) directly into the tumor, tiny capillary glass tubes containing from 3 to 5 mc. of the radium emanation, which are left permanently, and which give a tremendous radiation throughout a long period (Fig. 1). From one to several of these "spicules" may be implanted, depending on the size of the growth. This form of treatment should never be repeated under four to six weeks. In association with this method and also for the smaller definitely pedunculated tumors we treat with the emanation attached to a sound and encased in a brass or platinum capsule, which is held directly on the tumor (Fig. 2). For this we use the equivalent of one gram of radium in the form of emanation and treat on an average of from five to ten minutes on each existing tumor. Such cases are ambulatory or office patients and are examined and treated on an average of once a week for from four to five weeks. At the end of that period all treatments are discontinued and the patient allowed to go off for six weeks. Then another examination is made and the treatments again instituted, depending on the amount of trouble found remaining. With this method of treatment, instead of putting the patients to bed and exposing them to the risks and discomforts of an operation, we handle them simply as office cases, and in the meantime they lead their regular lives at home. Patients are never discharged as cured, but even after the last vestige of trouble has disappeared they are instructed to report at regular intervals for examination. The tendency to recurrence is so great that in this way we are able to treat a recurrence as soon as it becomes evident.

We have been using this form of treatment for the past three years with most gratifying results prompting us to further investigations along this line of therapy in the hope that in the near future the ideal radium technique might be realized to properly cope with this most distressing condition.

1418 EUTAW PLACE.

CANCER OF THE BLADDER.

Since carcinoma of the dome usually penetrates all of the bladder wall and the peritoneal coat, a part of the peritoneum must be excised. Transperitoneal operations are reserved for cases in which the peritoneum is involved. Although opening the peritoneum complicates the operation, it should be done if it is necessary to the performance of a complete operation; but it is not an aid in operating for the tumors of the base of the bladder, and therefore should not be made. A large incision down to the peritoneum, however, is very essential for exposure.

While the results obtained from radical operations for cancer of the bladder are not so good as we hope they will be in the future, they are not altogether discouraging.—E. S. JUDD and W. E. SISTRUNK in *The Journal A. M. A.*

REMOVAL METHODS FOR BLADDER STONES.

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The methods of removal for bladder stones have within late years been reduced practically to the following:

(1) Removal by litholapaxy, (a) under general anesthesia; and (b) under local anesthesia.

(2) By suprapubic cystotomy; (a) under general anesthesia; and (b) under local anesthesia.

Without reciting or discussing the numerous other methods that have been utilized for this purpose in the past, and that have been found lacking for various reasons and have therefore been placed in the discard, the ensuing remarks will be confined to the above-mentioned methods.

Litholapaxy.—In advocating this method Bigelow made use of the fact, previously determined by Otis, that the male urethra would tolerate the use of larger instruments (lithotrites, etc.) than had theretofore been recognized. This permitted the construction and use by Bigelow of stronger and more reliable instruments, not only for crushing stones within the bladder but also for their more prompt and effectual removal through the large-calibered washers that he also devised.

The promptitude and completeness of removal of the crushed fragments of stone was claimed by Bigelow as a markedly conservative feature of the method in respect to the mortality connected with the operation; and, as a matter of fact, litholapaxy eventually did considerably reduce the mortality of crushing operations.

Formerly the operation was done habitually under general anesthesia, but later the various methods of supplying local anesthesia have been improved to such a degree that it is the author's belief that one or the other of these is customarily used at the present time.

Following the usual aseptic or antiseptic preparation, two ounces of a one per cent, procaine solution may be injected into the emptied bladder, after which the deep urethra may be well anesthetized by dropping tablets of cocain (one and one-eighth grain), alypin or procaine into the deep urethra through the author's tablet depositor. One, two, or three of these tablets may be used until the patient declares that the sensitiveness at the neck of the bladder has been relieved. Through the same depositor tube six or eight ounces of warm water are introduced into the bladder, giving good working space for manipulation with the lithotrite.

This instrument is next introduced into the bladder, the patient being preferably in a semi-sitting posture, shoulders elevated and the knees resting in the knee-crutches of the cystoscopic operating table. The jaws of the lithotrite are opened within the bladder while the beak points toward the head of the patient. If the beak be pressed down into the base of the bladder during the process of the opening of the lithotrite there is much greater likelihood of promptly catching the stone and grasping it firmly in the jaws. On accomplishing this the lithotrite is lifted from the floor in order to avoid including the bladder mucosa in the grasp; the beak is brought out into the center of the bladder cavity, so to speak, and the crushing is accomplished by turning the mechanism in the handle. The grasping and crushing are repeated a number of times until the fragments are reduced in size sufficiently to pass through the washer freely. It may be necessary to turn the beak not only toward one side or the other of the bladder cavity, but also directly posteriorly in order to grasp the lesser fragments for further reduction.

The stone washer tube is introduced in the bladder following the removal of the lithotrite. The washing bottle filled with warm water is applied to the outer end of the tube, and the rubber bulb is then alternately compressed and expanded with the object of pumping the débris and small fragments of stone from the bladder. This appears in the wash bottle as a cloud of broken calcareous material.

When it is thought that all the material has been removed, the cystoscope is introduced into the bladder and if a few fragments are found they may either be crushed and removed through the washer or, if small enough, they may be grasped by the ureteral alligator forceps and drawn directly through the cystoscope sheath, or drawn out together with the cystoscope and forceps, if too large to pass through the cystoscope sheath.

Removal by Cystotomy.—The operation of suprapubic cystotomy under general anesthesia is so well understood at the present time that it is unnecessary to enter into a discussion of it. Suffice to say that it may be done under either gas or ether anesthesia or a combination of both.

Supra-pubic cystotomy done under local anesthesia has within late years become very popular and frequently adopted, particularly in cases of advanced age or great debility. It is perfectly feasible and highly gratifying, carrying the patient through the operation without shock or serious objection from any standpoint, save in those very

nervous individuals who have to be given some general anesthetic for their nervous sensibilities rather than for the prevention of suffering.

With the preliminary morphine injection, with the patient in a semi-Trendelenburg position, the bladder fairly well filled with warm sterile fluid, a line of infiltration after Schleich's method is effected for four inches above the pubis.

The first injections are made intra-cutaneously and the next are made sub-cutaneously; and when the incision has opened up this much of the wound, it is followed up with deeper injections into the fascia and depths of the muscular wall of the abdomen. The muscles are separated, the incision being carried well down toward the symphysis pubis. On reaching the pre-vesical tissues in the space of Retzius similar injections of Schleich fluid is introduced into these tissues.

It is well at this point to abandon the use of the knife in order to avoid incising the peritoneum, even though the bladder be well distended. The forefinger of each hand of the operator is covered with gauze and the bladder wall is exposed by blunt dissection with these two fingers, the fold of peritoneum being brushed upward and held in the superior angle by means of the retractor covered with gauze.

Before incising the bladder wall traction sutures of catgut are applied through it, one on each side of the median line, and then the bladder is emptied of its fluid contents by the catheter that has been left in the bladder since the beginning of the operation. By thus emptying the bladder by siphonage a comparatively dry field is obtained, instead of a sloppy one.

The vertical incision in the median line of the bladder is next made, sufficiently long to permit the removal of the stone or stones. This is accomplished by stone forceps or stone scoops; after which provision for draining is made by inserting a rubber elbow tube into the suprapubic opening and closing the bladder wall snugly around it with chromatized catgut sutures. The muscular walls are closed with interrupted catgut sutures and the skin with silk-worm gut. Complete drainage is well secured by means of one of the periodic suction apparatus on the market, such as that of Bremmerman. After a few days of drainage in this manner the suprapubic tube may be removed and the wound edges may be brought together by adhesive strips; at the same time drainage may be effected by an in-dwelling urethral catheter.

550 CENTURY BUILDING.

A NEW PRINCIPLE APPLICABLE TO THE TREATMENT OF GONORRHEA.

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NEW YORK CITY.

I published a preliminary note on a new principle for the treatment of gonorrhea in the *New York Medical Journal,* March 1, 1919, which should appeal to every urologist. It can also be utilized in any local infection as well as for gonococcal infection of the urethra. I have successfully used it in my private practice and in the genito-urinary clinic of the New York Hospital. Briefly, it is the introduction within the cytoplasm of the gonococcus, of a soluble agent which when injected into the urethra will penetrate the cell wall and reach the nucleus of the gonococcus without irritating the urethral mucosa. Such an agent must not be astringent nor produce any untoward effects liable to increase inflammation of the already congested lumen. This can be accomplished by a number of agents, notably by some alkaloids, amido-derivatives and aniline dyes. I show no preference to any one of them, because I consider that the chemical agent acts in a purely mechanical manner when "developed," as it were, by a second reagent, which must also be neither irritating, caustic, acid nor astringent and which in turn, will penetrate the cell wall of the diplococcus and reach its cytoplasm and nucleus, producing within the cytoplasm of the gonococcus cell-wall, chemical molecular exchange with formation of an insoluble, ponderable and voluminous precipitate.

It is reasonable to suppose that mitosis would be materially interfered with by the production of a dense precipitate within the cell, and that the chromosomes would be unable to perform those changes which result in cell multiplication, if what I have explained is brought about. This can be actually seen under the miscroscope by anyone who will take the trouble to stain large epithelial cells with dyes of various colors which precipitate one with another. Take, for example, pavement epithelium and stain with methylene blue, or cover the slide with a solution of quinine bisulphate. Wash the slide and again treat (this time while the slide is under the microscope) with a solution of picric acid. In both cases, the cytoplasm and the nucleus will show a distinct change of color, which proves that chemical exchange has taken place inside the cell. Of course, these changes take place in all cells of the urethra which stain with dyes or are chemically affected by colorless agents, but since the cells of the urethral mucosa are constantly be-

ing shed, this is of no importance. It is not claimed that by this principle we destroy the gonococcus (or any other cells) but certainly we prevent proliferation of stained gonococci so treated, and these are sloughed off with the pus and reproduction having ceased, the discharge disappears.

Whatever may be the scientific explanation, treatment with a sensitizing agent followed by a developing agent within the infected urethra will in many cases cause the gonococci to disappear from the urethra in from 24 to 48 hours. Why this is not always the case, I attribute to imperfect technique or too great haste in applying the treatment before the most severe inflammatory symptoms have been relieved by hot water compresses, bathing, and internally, bicarbonate of soda and bromides or something to soothe the intense irritation of the urethral canal.

I have made hundreds of experiments with various agents which it is unnecessary to mention because I find one just as good as another if the principle of treatment is kept in view.

Since beginning my experiments, Dr. Hugh Young, of Baltimore, has published his results with *mercurochrome*. I have used this as I have acriflavine, tolulol diamine and many others, but I find none has any special advantage. I am now using, principally, methylene blue as a sensitizer, and picric acid as a developer.

Technique.—Wash the penis carefully; introduce a *very small caliber* soft rubber catheter about 2 inches into the urethra, so as to allow return flow of any fluid injected. Connect this catheter with a long funnel. Any one of the following sensitizers may now be used:

Methylene Blue 1/2000
Acriflavine 1/3000
Tolulene-diamine 1/3000
Diazine Black 1/2000
Bisulphate of Quinine 1/500

(Any of these solutions give a heavy precipitate with solution of picric acid.)

Pour into the funnel 15 c.c. of any one of these sensitizers; allow it to enter the canal by gravity. Before the last few drops have left the funnel, add about 10 c.c. of solution of picric acid, 1/4000; allow this to run into the canal until the funnel is empty. All that now remains to be done is to wipe the liquid away from the parts to prevent soiling of linen.

This treatment may be given twice daily if convenient. In cases of posterior involvement,—it is necessary to introduce the catheter into the bladder and to use about 30 c.c. of the sensitizer. The catheter is then withdrawn and the bladder emptied. Now introduce the catheter a second time and pour into the funnel 15 c.c. of the picric acid "developer"; withdraw the catheter and again void the liquid. In this manner, the whole urethral lumen is covered by the reagents.

The only objection to any of these methods is the liability of staining the patient's clothes, but with careful manipulation and practice, this difficulty can be overcome to a large extent.

16 FIFTH AVENUE.

CHRONIC URETHRITIS.

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Chronic inflammation of the urethra is usually but not invariably, a sequela of gonorrhea. Exception is taken to the caption "chronic gonorrhea" because so long as the gonococcus is present the clinical state is subacute, and at any time may produce an acute exacerbation just as active as the beginning of the disease. The so-called "gleet" is also an unfortunate term, denoting nothing.

In the absence of gonococci the discharge is either mucous or contains one or two of the other pyogenic bacteria. The mucous discharge has its origin in the urethral glands, either diffusely distributed or in the crypts of Morgagni, the utricle, prostate or seminal vesicles.

In the male the urethra harbors from 15 to 35 different strains of bacteria in 20% of cases. These organisms though usually non-pathogenic, may become pathogenic under various stimuli. This is significant in calling attention to the non-venereal origin of urethral discharges, a fact of importance from a physical, therapeutic and social viewpoint.

There are many factors that predispose to chronic inflammation of the urethral mucous membrane and produce a discharge. These may be classified as follows:

1. Lowered resistence subsequent to gonorrhea.
2. Uncleanliness.
3. Constipation. Intestinal stasis and accumulations of feces in the lower tract are accountable for the greater percentage of non-venereal infections of the genito-urinary tract.
4. Secondary to inflammations of—
   Prostate and vesicles.
   Urinary bladder.
5. Traumatic—
   Falls and blows.
   "Stormy coitus"; so-called "strain" which

is a transient hyperemia and disappears without any treatment.

6. Mechanical—
   Instrumental, intraurethral masturbation.
   Foreign bodies.
   Brutal and careless instrumentation.
7. Chemical—
   Chronic alcoholism.
   Phosphaturia, seen in prostatics with residual urine.
   Hyperacidity of the urine.
   Concentrated irrigating solutions, usually potassium permanganate, also caused not infrequently by too intensive urethral prophylaxis.
8. Thermal—
   Too hot irrigating fluids.

In order to properly understand the pathology of chronic urethritis it is necessary to briefly consider the morbid changes of the urethral mucous membrane following its invasion by the gonococcus.

The infection begins with the lodgment of the gonococcus in the fossa navicularis by a suction process at the time of ejaculation. It spreads by propagation of colonies in a manner similar to the growth of the organism in the test tube. The infection probably spreads by direct proliferation of the organism.

The progression that takes place is first a superficial hyperemia due to the influence of the toxins liberated, according to Warden, by the autolysis of the gonococci. The invasion may extend then in either of two ways: Along the upper layers of the mucous membrane, or to the deeper layer into the ducts of the glands of Littré, thus involving the submucous connective tissue, the cavernosa and spongiosum. The picture now becomes one of any pyogenic infection: edema, vascular changes with leucocytic emigration, necrosis and necrobiosis, with pus formation in the regular order of suppurating inflammation.

The process may now become one of retrogression influenced by leucocytosis produced either by direct stimulation from the gonococcic toxins, or aided by the influence of drugs used in instillations. The gland ducts remain patent, drain spontaneously, the edema and hyperemia gradually disappear, complete resolution taking place.

On the other hand when the opposite occurs the ducts become infiltrated, "their mouths are glued over," thus harboring the gonococci, which may continue their activity and produce miliary abscesses or large abscesses which rupture either into the cavity of the urethra or externally, producing fistula.

Among other lesions that occur are small superficial erosions or ulcers that may develop at any site along the urethral mucosa. Fissures usually follow the crypts of Morgagni and may be very deep. The formation of granulations is one of the common processes in prolonged attacks; these may be discrete or diffuse and vary greatly in number. They are of two varieties; the soft type which bleed easily, and the infiltrating type, probably representing a more advanced change. These latter extend more deeply and if numerous undergo a subsequent metaplasia, producing a narrowing of the lumen of the urethra or formation of a stricture.

The staphylococcus may invade the glands of Littré and produce a marked infiltration of the crypts, subsequently causing a stricture of the resilient variety. This organism and the colon bacillus do not often penetrate the deeper structures to produce a peri-urethritis.

The pathologic changes of the verumontanum as described by Rytina are, "a submucous and peri-acinus infiltration of round cells. The infection travels down the length of the sinus pocularis into the invagination below, showing the necessity of injecting the canal, as first suggested by Luys and later by Geraghty. Involvement of the sinus no doubt is a most important factor in perpetuating or rekindling urethral discharges."

Changes in the seminal vesicles undoubtedly are incidental in keeping up or at least in contributing toward a chronic inflammation of the urethra.

There may be no subjective symptoms, on the other hand the patients complain of some pain, usually in the region of the bulb; perineal discomfort, itching, and painful priapism are often present. If the pathology involves the veru or prostatic urethra there is frequency of urination.

Objectively we have to consider the discharge and the urine. The former may be only the morning mucous "drop," it may be sero-purulent or purulent. Any of these types of discharge may characterize the post-gonorrhoeal urethritis.

The urine in chronic urethritis which results from gonorrhea is usually clear with either "pus" or "mucus" shreds present, dependent upon the degree of epithelial exfoliation in process.

The non-specific bacteria may be found on direct smear. The urine may be turbid if the bacteriuria is very pronounced. Blood in the urine is a terminal occurrence and represents probably the squeezing out of some red cells from the granula-

tions. A severe hematuria is rarely associated with chronic urethritis.

The importance of diagnosis lies in the recognition of the cause of the existing or persisting discharge by localizing the pathology on the one hand, and determining the etiologic factor on the other. The history is of value; the examination of the discharge is, of course, most important, but it is often absolutely impossible to make an accurate diagnosis from "smears" alone. Cultures must be made, without this accurate diagnosis no rational therapy can be instituted.

For localization of the active lesion the urethra must be explored by the endoscope and the cystourethroscope. No physician is competent to treat these cases without the ability to manipulate these instruments. Finally, digital palpation per rectum and examination of the expressed discharge from vesicle and prostate will complete the exploration of the foci which may be producing the continued discharge.

Chronic urethritis must be differentiated from urethrorrhea and prostatorrhea.

There is a wide range of opinion as to the length of time the gonococcus may persist in the male genito-urinary tract. E. L. Keyes, Jr., states that he has "never known the gonococcus to persist in the male urethra for more than three years, while in at least 90% of cases it disappears with or without treatment within a year." It is, of course absolutely impossible to know in each case exactly when the individual ceases to harbor the gonococcus but if the following rules are observed it will be very rare indeed that error will occur.

If the infection was limited to the anterior urethra, one year must have elapsed from the time of the last evidence of the infection before consent is given for marriage. If the infection extended into the posterior urethra, thereby involving prostate and vesicles, then two years must elapse after the final clinical disappearance of the disease.

A primary non-gonorrheal urethritis does not often become chronic, but may be due to the influence of one or more of the pyogenic bacteria gaining entrance to the urethra through its lowered resistance following a gonorrheal infection. The bacillus coli, and staphylococci in combination are more resistent to treatment. They may be exterminated and the mucous discharge may still persist, until the lesion producing it is localized. Finally it must be admitted that there are some cases, fortunately in the minority, in which, despite every rational means of therapy, the "morning drop" will persist. If no pathology is determinable and the urine shows only mucous shreds, the patient should be frankly told that he can never be freed from the condition, but that no harm can ever result from it, either to himself or to a prospective wife. This statement is made with the reservation that the points mentioned are taken into account.

In considering the treatment the patients should be divided into three groups; (1) those in whom the urethral affection is a simple diffuse chronic hyperemia, with slight epithelial exfoliation, manifested by shreds in the urine; (2) those, who, upon urethroscopic examination show localized lesions along the urethra such as fissures, ulcers, granulations, etc.; utriculitis and verumontanitis; (3) those in whom the prostate or seminal vesicles or both are the offenders.

For the first group, the passage of sounds followed by instillations of silver nitrate ¼% to 1% and massage of the urethra, is the program to be carried out.

Any of the localized lesions in the second group should be touched with silver per endoscope; beginning with 10% and increasing to 25% or even the pure stick made into small molds for this purpose and carried by the Young porte caustique. For gaping Littré glands and for any involvement of the utricle, direct injections 1% to 3% silver are made with the Geraghty syringe.

For the third group, systematic stripping of the vesicles and massage of the prostate should be carried out. This can be followed by deep instillations or irrigations, but in the writer's opinion these procedures have little value, but in these cases can do no harm. When after a reasonable length of time conservative measures fail, vasotomy should be performed. In my experience in approximately 75% of the cases satisfactory results are obtained. Vesiculotomy is condemned as a difficult and serious operation and not productive of any results.

If the discharge shows an admixture of either colon bacillus or the staphylococcus, for the former organism ½% solution of aluminum acetate gradually increased to 2% upon tolerance is effective. For the other organism 1:5000 solution of mercury oxycyanide is almost specific therapy.

31 NORTH STATE STREET.

CYSTITIS IN THE FEMALE.

Continuous irrigation of the female bladder with sterile water by means of a two-way catheter is a simple and harmless procedure and is of great value in certain cases of severe ulcerative cystitis. —ALFRED P. JONES in the *Virginia Medical Monthly*.

URETHRAL ABSCESS.

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From the standpoint of the canal as the source of infection urethral abscess includes the involvement of all glands; mucous follicles, Cowper's and the prostate gland. The length of this paper permits only a survey and not a detailed discussion proper for each of these complications.

The practical are the most important points and naturally involve pathology, diagnosis and treatment as preëminent because the other clinical facts are sufficiently familiar to be omitted. In gonococcal and non-gonococcal urethritis all glandular infection occurs without or with occlusion of the duct. Patent ducts provide drainage and constitute in the large glands follicular inflammations, very important in the prostate but not within the meaning of the title. Closed ducts cause parenchymatous disease or abscess whose size is a mere detail. The process in essence, involvement, temporary, permanent, associated and complicating lesions is identical in kind though widely different in degree. In this symposium the gonococcal forms are the types which all others copy except tuberculosis and syphilis, which must also be omitted. The distinguishing factors between gonococcal and non-gonococcal forms are basically the organisms and their products in the tissues.

Elsewhere[1] these processes are detailed for each glandule and gland. The chief elements to remember are the continuity of the mucosa of the urethra with the gland cavities and the identity of the pathological processes thereon and progress therein, whether they be in the urethra or the glandules and glands. The gross regions may be disregarded for brevity; but the microscopy is important because it reveals how closure of ducts occurs. What appears in the mucous follicles is duplicated in the larger glands and is the following pathogenesis. A migration of the gonococcus with its penetrating destruction occurs. Pus-slugs appear through thickening of the lining and wall, then closure and enlargement to shotlike masses along the urethra. Extension means involvement of surrounding tissues and finally rupture into the urethra unless intervention provides otherwise. Occasionally the rupture occurs on the skin. Termination is destruction of function and often of anatomy. Chronic catarrhal inflammation with or without persistence of gonococci is not uncommon and pus-bearing and urine-bearing fistulæ upon the skin are occasional. In Cowper's gland these processes are simply extended, and sequels duplicated. In the prostate the process still further extends. "In termination the phlegmon evacuates according to its site and the periprostatic infection: (1) internally into the urethra, bladder, vesico-rectal space, rectum and peritoneum, and (2) externally, usually upon the skin of the perineum. The complicating lesions of prostatic abscess are due to penetration into or association in the periprostatic spaces of the initial infection, with burrowing of the pus determined largely by the original sites: (1) backward into the rectum by abscesses originally near its cavity; (2) downward into the perineum, sheath of the penis or scrotum; (3) laterally into the ischiorectal fossae and thigh, and (4) upward upon the loins and back. Pockets, sinuses and seminal, urinary or fecal fistulæ are often the sequels of such complications."[2]

The diagnosis rests on the subjective symptoms partially, but on the objective signs almost totally. It must not be forgotten that some patients for a shorter or longer time show absorption especially when the glands of Cowper or the prostate gland are concerned. Abscess of the prostate has often been mistaken for typhoid fever because rectal and urethral examination were omitted. In all these complications the local subjective manifestations are varied only by the activity of the process and include "(1) sensory: pain and weight in the perineum, rectum and bladder in the deep pelvis or referred down the thighs and into the loins much as uterine pain in the female, and (2) vesical: dysuria, pollakiuria, tenesmus through congestion and irritation, and retention of urine by edema or spasm; (3) sexual: chordee and painful, bloody, seminal emission, and (4) rectal: pain in defecation, altered stools and obstipation, through mechanical pressure and tenesmus through reflex action or periprostatic invasion."[3]

The objective findings are urinary and rectal. The urinary signs are pus in all test glasses, slugs, detritus and blood occurring with prostatic disease. The writer's seven glass test should be omitted unless the case is quite mild and not recent. Those who are not familiar with it should never use it until they have acquired the necessary dexterity and judgment with chronic lesions. This test belongs to subacute and chronic conditions. The rectal signs include the perineum and show the abscess at one or more points or in one or more lobes of the prostate or in the whole gland. Like-

[1] A text-book of Urology in Men, Women and Children. Pedersen, 1919.

[2] Pedersen, *loc. cit.* p. 117.

[3] Pedersen, *loc. cit.* p. 118.

wise Cowper's gland or glands present in the perineal body on bimanual examination as abscesses of common characteristics attached to or in relation with the urethra. The mucus follicles may be single or multiple and scattered along the canal like shot discernible without or with a soft rubber catheter passed to the bulb. The signs of abscess are further fever, prostration, depression, nausea, vomiting, white cell count, sometimes bacteremia and occasionally the positive complement fixation test. If the abscess has ruptured, then the path of the fistula is apparent through urethroscopy and the use of probes, filiforms and dye injections. The differential diagnosis chiefly concerns organisms other than the gonococcus and the exclusion of abscess in other parts of the body and other diseases notably typhoid fever. The Widal reaction, the typhoid bacilli in blood, excreta and urine together with the presence of the urethritis and its complications makes such a diagnosis almost inexcusable, if it were not for the fact that lower grades of prostatitis may not cause much local disturbance. The patient goes to bed sick, hides his venereal disease and deceives the physician for a short time.

The treatment varies with the complication. Prophylaxis consists in the thorough diagnosis of the type and tendencies of any urethritis. One that is seen to extend itself rapidly along the urethra and show subjective symptoms while still a urethritis proves an aptitude toward complications and requires the utmost conservatism. Rest in bed at the first appearance of sympathetic congestion of the prostate is in order, if possible without betrayal of the patient. Local measures in home or office should be abandoned, a suspensory worn and disturbances through errors in exercise, food, drink, indirect and direct sexual excitement avoided. The decongesting influence of hot hydrotherapy and of phototherapy to the limit of mild burn (without blisters) of the gluteal and posterior thigh regions are valuable. Other physical measures such as massage and electrotherapy belong to a later period, except in very skilled hands. The writer had a patient with acute gonococcal prostatitis in whom he dispelled the gonococci in three weeks without extension to the vesicles or testicles by means of the insulated vacuum rectal electrode attached to the negative pole of the static machine, with the positive pole grounded, for twenty to thirty minutes every other day. The significance of this case lies in the fact of severe infection fully controlled by a relatively unfamiliar method without extending the disease or disturbing the patient for even one day of ordinary life. The failure of the case as a complete cure is resident only in the man's stupid neglect of continued treatment for perhaps another three weeks. He himself really lost the opportunity of short and probably complete relief of a severe follicular prostatitis without added complications, or extension into abscess.

In the operative treatment the writer believes that he has demonstrated the efficiency of the following procedures. A follicular abscess at the meatus must be opened into the urethra. Removal of the urethral wall of the abscess through a V-shaped flap with its base at the meatus is very important because the cavity then cannot recur and must granulate. Follicular abscess along the canal should not be opened into the urethra, but very freely indeed through the skin exactly as is done with Cowper's gland. The writer usually makes this skin incision three times the diameter of the abscess so that the skin cannot possibly close before the cavity fills with granulation. While operating the cavity is wiped with gauze and never curetted, for fear of opening into the urethra. For the same reason applications such as iodine are not employed.

The writer is convinced that any operation which opens a prostatic abscess into the cavity of the urethra is a serious mistake because the only result thereof must be blind pouch or sinus or fistula in which urine accumulates and decomposes. Too many such cases are encountered through systematic urethroscopy to make any other opinion possible. "The technic of operation is simple for cases with pus present to the examining finger by the enlargement, tension or fluctuation, or with pus indicated by severe absorption closely simulating typhoid fever, with which they are sometimes confounded during the first few days. Equipment is the same as in external urethrotomy with a guide, and the preparation of the patient is that usual for any major operation and of the field by any recognized method, of which none is better than tincture of iodin, provided the scrotum is not thickly coated. Anesthesia is by choice general on account of the uncertainties of the deep dissection, but may be spinal in occasional cases, and rarely local because the inflammation makes the instillation so painful. Posture is exaggerated lithotomy and general landmarks are the rectum behind, base of scrotum in front with its raphé, the tuberosities of the ischia and the urethra made prominent by the author's irrigating sound. The incision should leave the urethra intact and be made over the prominence of the swelling in unilateral cases and over each swelling in bilateral, discrete cases, exactly as in bilateral cowperitis and over the abscess as a whole in bila-

teral confluent cases. Its form may be straight and oblique, horizontal or curvilinear, as in perineal prostatectomy. The horizontal incision is to be preferred when possible because it most conserves the muscular structures of the perineum, gapes longest for drainage and is in general parallel with the prostatic ducts. The superficial field is the perineal skin, fat and fascia and avoids the muscles as far as possible by blunt dissection to the lower surface of the gland, which is the deep field. If pus is not apparent to the finger an aspirating needle will locate it, upon which as a guide the straight blade sharp point bistoury is entered and the prostate divided to the limit of the skin incision. The finger in the wound now explores the cavity of the gland for other foci and gently breaks them into the main pocket. The rounded tip of a velvet eye catheter is passed into the wound for irrigation and stitched to the skin for drainage combined with one or more cigarette drains which with external dressing and a good T-binder still all hemorrhage. No suture of the wound should be necessary. If no pus is located free incision is warranted as a relief of hyperemia and absorption. Pus will appear in such a wound quite regularly after a day or two.

"The disapproved methods are puncture of the abscess, with trocar and cannula, through either the perineum or the rectum, because neither route nor instrument gives adequate drainage, and the rectum becomes infected with gonococcus and the abscess, with the flora of the bowel, notably the bacillus coli-communis."[4]

The immediate after-treatment respects toilet of the cavity of the abscesses and if the bladder is involved the toilet of that viscus also. Drainage with gauze and tube with suitable dressing vary with the site and size of the cavities. Remote aftercare continues the said dressings, removes the tube and decreases the gauze drainings according to indications and prevents premature closure of the skin before the cavity has granulated. Resumption of treatment of the antecedent urethritis follows only after danger of tearing into the abscess cavity is over through sufficient granulation. Caution and conservative judgment require the urethra to be left alone by all except experienced hands. Intrinsically all these cases belong to the hospital and office service of the specialists.

In these days the social service side of venereal disease is fully as important as the professional service to the patient, because the former aims to prevent infection of the innocent outside or inside of wedlock. Such social service belongs alike to hospital and private practice and its meaning warrants the following quotation from the work already named (p. 126) and may be applied to all three lesions under discussion.

"Cure is not possible for entire restitution in the pathological sense, but relief from all symptoms and restoration to nearly normal physiology is usual in the symptomatic aspect. Return of the urethral mucosa to absolute normal probably rarely occurs. Perhaps most important of all is relief from infectiousness in both the follicular and the parenchymatous forms, thus constituting bacteriological cure—a most important sociologic matter, because the prostate is copiously and directly related with the production of semen."

It is regretted that three cognate yet highly different conditions were required by the title assigned; but it is hoped that the aim of making the practical point emphatic has been successful.

45 WEST NINTH STREET.

[4]Pedersen, *loc. cit.* p. 125.

ON THE STRICTURES OF THE MALE URETHRA.

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Anatomy.—The male urethra consists embryologically of two parts, a posterior segment beginning at the bladder and ending at the ejaculatory ducts, and an anterior segment which comprehends the remainder of the canal. Considering the regions of the body in which it lies the urethra can be divided into pelvic, perineal and penile portions. In relation to strictures it is better to consider the urethra as of prostatic, membranous and spongy portions. An abnormal narrowness of any portion of the canal of the urethra constitutes a stricture. Indeed, a simple hardening of the musoca of the urethra is capable of forming a stricture. The urethra is not a simple canal to let the urine pass, but it acts like a valve, which with its muscular layers squeezes out the urine to the last drop. When the mucous membrane has been hardened and changed in its delicate structure, if yet there is no organic narrowing of the organ, yet the hardened mucosa prevents the last drop of urine from coming out, one or two drops of urine remain beyond the hardened mucosa and maintains a constant irritation which constitutes the so-called gleet.

The urethra has not the same calibre all the way through. The meatus, the middle of the pars pendula and the beginning of the pars membranosa are naturally somewhat narrower. Other parts of the urethra are enlarged, so after the meatus the fossa

navicularis is much larger, before the pars membranosa is another enlargement forming the bulbar urethra, while the prostatic portion is an enlargement in the shape of a triangle. At this point the ejacualtory ducts and the prostatic ducts open, and from this point infectious materials reach those organs. The pars membranacea runs from the prostatic portion to the bulb going through both layers of the triangular ligament, surrounded by the fibers of the compressor urethrae muscle. Behind it the glands of Cowper lie, the excretory ducts of which open at this point in a narrow space the least distensible of all parts of the urethra. This is just in the curve, less movable because it is firmly fixed to the symphysis. On account of its curve the anterior wall of the mucosa is shorter than the posterior.

The wall of the urethra is formed by a mucous membrane containing a rich venous plexus, and in the prostatic and membranous tract it is well clothed with muscular tissue. The mucous membrane has an epithelium which varies in the different parts of the urethra. The proximal two-thirds of the prostatic portion resembles the epithelium of the bladder. At the pars membranacea the epithelium takes the aspect of the columnar type. This epithelium covers the rest of the urethra to the fossa navicularis where it is changed into stratified epithelium. The meatus is the continuation of the epidermis covering the glans.

The muscular fibers are some striated and some non-striated. The non-striated, involuntary, are incorporated in the wall of the urethra, while the others are in the form of accessory bundles derived from structures surrounding the urethra. Some of the intrinsic muscles are longitudinal, forming the first coat, and some are transverse or circular. The circular fibers, well developed, form a thick layer especially towards the internal orifice. The removal of all urine at the end of micturition is due to the action of the muscular tunic.

Varieties.—Stricture may be spasmodic, the result of the contraction of the compressor urethrae, which may impede temporarily the passage of the urine from the bladder. Keyes[1] refers to this condition—the abnormal urination in nervous individuals, who cannot urinate in the presence of others. After an operation for hemorrhoids in some individuals the urination becomes difficult and spasmodic. This kind of stricture is not permanent, being only of spasmodic nature, yet it must be relieved to avoid disastrous consequences in the urinary organs. In these strictures the use of the filiform bougies will increase the irritation while a good size catheter will be easily passed and will tire the spasm of the muscle. In withdrawing the instrument no grasping is found. Sometimes, however, a spasmodic stricture coexists with an organic one and the spasmodic stricture may be the result of the other.

The spasm is easily overcome by the use of hot sitz bath, by the administration of opiates, and later by the insertion of a metallic sound. To prevent recurrence the passage has to be dilated, the muscle stretched, and in order to diminish the sensitiveness, the instillation of a few drops of a solution of silver nitrate 1 to 1000 will be of a great value.

The strictures which we shall consider here are the sequel of urethritis. They consist in a contracting periurethral formation of fibrous tissue, after the reabsorbtion of the infiltrating elements deposited in the submucous layer during the inflammatory process. The mucous membrane becomes hard, thickened in some places; the lumen of the urethra is not narrowed, but yet the function of urination is impaired. This can be considered the first stage of the stricture. When, however, the process of infiltration in the submucous tissues heals, on account of the sclerotic changes in the connective tissues, it forms a scar, which retracting the tissues causes the narrowing of the lumen of the urethra. Consequently there are two kinds of strictures; the first soft, easily yielding, which rarely affects the dimension of the urethra, have been called after Otis *wide caliber strictures;* the second kind formed by hard retracting tissue have a tendency to narrow the caliber and are known as organic strictures.

It is a difficult task to state when the large caliber stricture begins and when it ends, but it is true that the large caliber stricture is the beginning and the callous stricture the end. A stricture can be formed in any part of the urethra, but some parts are more subject to the strictures than others. Thompson reported 320 cases of strictures of the urethra of which 54 were seated in the beginning of the urethra from the orifice to two and one-half inches of the pars pendula; 51 were in the middle of the pars pendula; 216 were found in the subpubic curvature in the bulb and in the membranous urethra. The frequency of strictures in these regions is due to the fact that they are exceptionally vascular, and on account of the curve the chronic urethritis is apt to localize at those points. The abundance of follicles in the bulbar region favors submucous exudation. Traumatic stricture is found more often in the membranous urethra.

A stricture may be formed in ten or twelve months after the apparent cure of urethritis, while

others are noticed a period of years afterwards.

Etiology. Strictures may be produced by trauma or by gonorrhea. According to Thompson and Martin those from gonorrhea are much more frequent than the others. As a result of urethral chancre and from ulcerated gummata we have seen deformities of the meatus and cicatricial formations of the fossa navicularis, but it seems that stricture of the urethra proper are chiefly the consequence of a gonorrheal process.

A stricture may be alone, but not rarely do we find more than one stricture in the same urethra. Although Thompson in his statistics amongst 270 cases of strictures has found only 44 cases of multiple stricture, yet Guyon has established as a rule, that strictures of gonorrheal origin are multiple, while those of traumatic origin are single. In our experience with strictures of gonorrheal origin we have found only rarely two at a distance from each other in different portions of the urethra. In some cases a gonorrheal stricture may present a number of ridges to the exploring bougie and so give the sensation of multiple strictures while pathologically it is one.

Gonorrheal strictures are much more frequent than traumatic. Thompson placed them at 75 per cent., Martin at 85 per cent. Gonorrhea itself is sufficient to produce stricture and this is the cause in most of the cases. In some cases, however, the stricture may have been caused by gonorrhea and trauma together as in the injuries of the urethra resulting from the superstitious suggestions of breaking the chordee, or from caustic injections, or from the injudicious use of instruments.

Traumatic strictures have been found to be the result of a fall on the perineum. Prezzer[2] referred to the observations of Millee of seven cases of urethritis caused by riding on the bicycle, and two cases of ruptures of the urethra followed by stricture. In individuals who have practised masturbation stricture has been found, being the result of tearing of the mucous membrane in the spasm of the pernicious act.

Pathogenesis. It is easy to understand how a stricture is formed in a portion of the urethra, by remembering the changes, which the conjunctiva undergoes in a case of gonorrheal ophthalmia. The gonococci after producing acute urethritis, have an inclination to enter the epithelial cells, and, going through them, find shelter in the deep epithelial layer towards the connective tissues. Usually they limit their action in limited portions of the urethra, where they are less disturbed, as in the glands, lacunae Morgagni, in the places where the walls of the urethra are closer together as at the beginning of the bulbar region. A chronic inflammatory process results with an infiltration, which, together with the irritation of the connective tissues of the subepithelial layer, starts the papillary proliferation. At this point by means of the urethroscope the mucous membrane appears dark red, granulated, it is somewhat thicker, hard and inelastic. This is the beginning of a wide-caliber stricture. In some cases in the spongious tissues a kind of inflammatory knot is formed, very painful, hard to the touch. This usually does not form an abscess, but is reabsorbed. When the infiltration disappears the affected trabeculae of the spongious tissue shrink. Their connective tissues, hardened, undergo a sclerotic process. This causes atrophy of the spongious body with narrowing of the lumen of the urethra, and formation of the stricture.

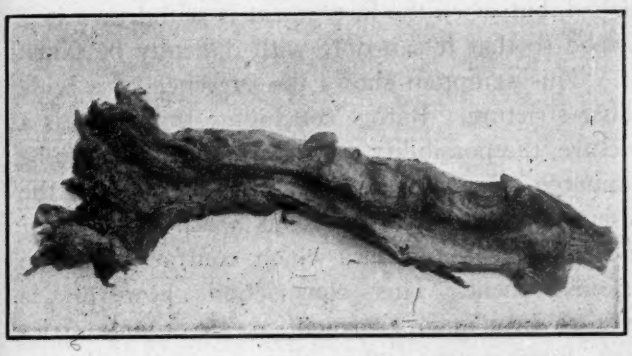
It is not always an acute process which causes infiltration of the trabeculae of the spongious tissue, but more often a chronic inflammatory process is equally responsible for the induration and the infiltration of the spongious tissue of the urethra. This process which can be diffused through a great tract of the urethra is usually limited to a small portion. (See illustration). The process consists in the increase of the connective tissues of the trabeculae, which makes the alveoli much smaller, and the delicate spongious tissue is converted into a hard and thick degenerated sclerotic tissues.

The work of Vajda, Neilsen, Baraban, Finger, Wassermann, Nadli and Guyon have contributed a great deal to clearing up the pathology of strictures. It seems that the anatomico-pathological process is the same throughout, which from the chronic urethritis gradually brings about the stricture. In the urethritis we find an inflammatory process, which is localized in spots, affecting the epithelial and the subepithelial tissues. In the beginning the acute stage produces infiltration of serum and of small white cells, which infiltrating the connective tissues causes their proliferation and so their thickening and swelling. Gradually the infiltrating cells are reabsorbed, spindle cells go on forming connective tissue bundles, which are changed into a thick succulent superficial cicatrix covered with an abnormal epithelium. When these alterations have diminished the elasticity of the urethra in its deeper layer, and when the cicatricial formation has extended to the corpus spongiosum, then the portion of the urethra loses its elasticity, its normal caliber is narrowed and the organic stricture has formed.

Of course that portion of hardened mucosa retains a few drops of urine which remaining behind

the impediment irritate the mucosa and maintain a certain degree of irritation. Guiard[3] thought that the virulence of the urethritis was the cause of the production of the stricture. We have often found strictures following cases of urethritis, which on account of their mildness had been neglected.

The strictures have been described as linear, annular, irregular, tortuous, etc., which are only clinical distinctions to indicate the quantity, the shape, the disposition of the scar tissue, which at times forms a thin band and at other times an irregular mass.



A stricture, post-mortem, appears yellowish-white in color, hard and fibrous in consistency, of different sizes and shapes. It has no hyperemia, swelling or infiltration when seen through the urethroscope during life. The epithelium is thickened, whitish and resembles a superficial cicatrix. The subepithelial tissue when the swelling is gone does not show much change, microscopically, but in some cases the surface is ridged, uneven and even nodular. When the stricture has been much advanced a band of cicatrix replaces the mucous membrane, penetrating into the corpus spongiosum. Behind the stricture the canal of the urethra is distended, abraded and superficially eroded.

Microscopic examination shows the epithelium thickened, its cylindrical cells in condition of mucoid degeneration. Pus cells are found imbedded between the layers of the epithelium (Finger[4]). The thin cylindrical epithelial cells are converted into a hard thick pavement-like epithelium. The change of the cylindrical into plaster epithelium is of itself a cause of necrosis of the mucous membrane, which is connected with the alteration of the subepithelial connective tissues.

In recent cases the infiltration surrounds the lacunae and the glands, which imbedded in the subepithelial tissue, after a while become atrophic and disappear. In many cases the inflammatory process remains superficial and produces only a superficial non-constricting cicatrix. In other cases the process is deep, affects the periurethral tissues as far as the corpus cavernosum and forms a thick retracting stricture, as a result of cavernitis complicating the chronic urethritis.

There is a great difference in the amount of retraction between strictures of large caliber and those narrowing the canal. In the first a superficial thickening of the mucosa and the superficial layer is formed, which deprives the portion of the organ of its elasticity and retains a few drops of urine, maintaining a constant irritation. The others, thick, hard, deeply contracted, will scarcely admit a slender sound.

Symptomatology. The symptoms from which we ascertain the presence of the stricture in the urethra are some suggestive, some subjective and some objective or physical.

A long-standing gleet will suggest the presence of a stricture. The patient in the morning squeezes out of the meatus a little drop of clear or milky or even creamy fluid. In some cases the fluid is scarcely perceptible, becomes dry and sticks the lips of the meatus together. In many cases of stricture the gleety discharge is missing.

Whether a gleety discharge accompanies the stricture or not, the urine shows the presence of shreds. These are small, short, or like a light cloudiness, while at other times they are heavy, thick, twisted and soon sink to the bottom. On account of the increased acidity of the urine, the stricture is irritated and contracts, then the sypmtoms of posterior urethrtis grows worse, and the urine becomes cloudy. These exacerbations are considered by the patients as new attacks of gonorrhea.

At this point the patients suffer from what is called irritable bladder, with the necessity of urinating frequently (Hirsch[5]). It is not the nervous bladder but a catarrhal inflammation extending from the posterior urethra to the neck of the bladder, which causes the necessity to urinate, when it is touched or slightly distended by the urine. The frequency of urination varies, and it is felt especially at night, compelling the patient to get up several times to empty the bladder.

The presence of urine in the bladder, on account of the irritability of the genital organs, causes frequent erections at night, which, although not accompanied with loss of semen are troublesome to the patient. In some cases the patients have frequent loss of semen. At times the erections are painful, the stricture prevents the discharge of semen in the sexual act, which either dribbles out of the urethra or runs back into the bladder and is discharged with the flow of urine. In many cases

of stricture the patients complain of diminution of the sexual appetite and some of impotence.

Subjective Symptoms—A stricture in the urethra impeding micturition causes change in the stream either during the whole urination, or at the beginning or at the end. The size of the stream may be reduced sometimes to a mere thread. Often the stream is divided into two, spurting in different directions, at times it is tortuous or twisted. The projection of the stream, which is the result of the intensity of the contraction of the detrusor vesicae is greatly impaired, and the last drops which remain behind the stricture dribble out without any force of expulsion. In some cases the urine begins to flow, then stops and the urination is finished at intervals. Painful micturition as a consequence of stricture is rare, and exists only when cystitis or prostatitis has developed, or when the urethra on account of inflammation is sensitive to distension. When the posterior urethra is inflamed pain is felt in the beginning of the urination and at the end, when the last drops are expelled.

When the bladder, still normal, cannot empty on account of the strictured urethra, this may cause spasmodic pains. The pain from the bladder radiates towards the rectum and the urethra. Only in rare cases the stricture may lead to retention of urine. It is the result of an engorgement of the peristrictural tissues, which arrest the normal emission of the urine. According to Valentine[6] this condition is precipitated by alcoholic or by sexual debauch.

It has to be remembered that on account of the continuous straining to urinate, the patients are subject to hemorrhoids and also to rectal prolapse.

In severe cases of stricture the bladder undergoes a process of inflammation not only catarrhal, but parenchymatous in character. The ureters and kidneys are also badly affected by the continuous pressure, and may be involved in a form of pyelonephritis. The presence of the urine back of the stricture forms a dilatation, which may let the urine infiltrate causing extravasation, perineal abscesses, and urinary fistula.

In many cases the stricture of the urethra is responsible for sexual neurasthenia, pruritus of the perineum and rectum, persistent and recurrent herpes progentalis, and even dyspepsia and pains in the stomach.

Objective symptoms are all positive signs which we obtain by means of instruments. It has to be remembered that when discharge is present, it has to be examined microscopically. If there are gonococci in the secretion it is dangerous to introduce instruments. In this case it is better to have the patient treated by the irrigation method.

When no more gonococci are present or no more secretion and the patient shows irregularity in urination, in order to ascertain the presence of the stricture and its location, we introduce a blunt steel sound. The first time we use a sound which easily enters the meatus (10 or 12 American) which, after having been sterilized and well lubricated is introduced with great gentleness.

In some cases the sound is introduced without encountering any obstruction until the bladder is reached, but when the instrument is withdrawn it is grasped so that it can only with difficulty be taken out. This symptom shows the presence of a wide caliber stricture. Before concluding that there is a stricture, the possibility of urethral spasm has to be eliminated. In some cases the irritation from the presence of the sound provokes a reflex action of the muscles of the urethra which, contracting, grasp the instrument. This constriction, however, is never so firm and permanent as an organic stricture. Furthermore, when the constriction is the result of the stricture a discharge of one drop of mucous milky secretion follows the withdrawal of the sound. This drop of secretion is of urine, mucous, saline particles of the urine, which had remained behind the strictured point, and when the sound has distended the stricture it finds its way out of the canal.

In some cases, in order to ascertain the presence of a wide-caliber stricture, it is better to use an olive-shaped bougie, as recommended by Pousson[7], Jurquet[8], and Valentine[9]. The olive-shaped bougie is easily introduced, but when withdrawn it is grasped firmly by the strictured portion of the urethra. In other cases, when the stricture has already impaired the lumen of the canal an obstruction if encountered which prevents the introduction of the sound. Then it is necessary to try smaller blunt sounds until it is found possible to pass the stricture.

When the presence of a stricture has been ascertained it can be easily located in the different portions of the urethra, and can also be measured by means of olivary bougies, or by the urethrometer of Otis. In reference to this instrument Lovenhardt[10] and Stewart[11] caution the surgeon that it is dangerous and questionable practical utility.

Prognosis. In a general way we may state that strictures of the urethra do not occur as often as is commonly believed. Jurquet in 1,420 patients with diseases of the genito-urinary tract found 133 cases of strictures of the urethra of which 25 were of

large caliber. From our own experience we can assert that the incidence of strictures has greatly diminished. The active propaganda on social hygiene, the exact knowledge of the cause of gonorrhea, and the judicious and rational treatment at the reach of every practitioner have had a great influence in this diminisition. Von Sehlen[12] wrote that the formation of a stricture is scarcely possible when a well directed treatment for gonorrhea is applied. To this has to be added, when the patient applies early to the physician, and when the physician has thorough knowledge of the treatment.

In reference to the stricture itself we can say that the prognosis depends upon the nature and the location. Traumatic strictures have a tendency to contract rapidly, while gonorrheal strictures have slow course. Strictures of the perineal urethra are more difficult to treat than those of the pars pendula. When a stricture is extensive and deep, having its base in the cavernous tissues it will never be completely cured. It will be relieved by the use of sounds or by operation, but it will gradually relapse.

As to danger to life, it has only rarely occurred that a stricture has caused death. In rare cases death has been the result of extravasation of urine, followed by abscess and gangrene. In other cases death has been produced by chronic uremia, when the kidneys have been involved in an inflammatory process. In other cases death may be the result of cachexia and exhaustion from pain and from the torments caused by an old impassable stricture. The patients lose sleep, fail to eat from the unrelieved desire to urinate, and from the fatigue and the labor of difficult urination.

Treatment. The treatment of urethral strictures has for its aim to enlarge the lumen of the urethra and maintain its enlarged caliber by dilatation.

Dilatation is effected gradually and gently by the use of sounds, which massaging the scar tissue of the stricture provoke its absorption. Keyes stated that the maximum of effect is produced by the minimum of effort, which coincides with the opinion of Guyon, that the effect is due not to the pressure of the sound, but to its mere contact. Passing a sound by force, will tear and bruise the mucous membrane and consequently increase the inflammatory reaction. A steel sound must go in without effort. In this way the presence of the sound will be able to lessen the congestion at the point of contact, correct the irregularities in the canal and stimulate the deeper tissues to a reaction so as to soften the cicatrix. In our practice we have entirely abandoned the method of forced dilatation and of divulsion, which some years ago were largely applied with serious consequences.

When the stricture is yet soft or in a semifibrous stage, it can be easily removed by prompting the reabsorbtion of the infilerated elements by means of gradual dilatation.

The dilator of Oberlander marked a great progress in the therapeutics of strictures. It was found however that the two blade dilator was not sufficient. Kollman has given us his admirable dilator, which consists of four blades which open in opposite directions. The instrument when closed is not larger than an ordinary sound 22 Charrière. It is introduced in almost any urethra without the necessity of meatotomy. We have used the dilator quite often for many years, but gradually we are using it less frequently, relying mostly on the use of steel sounds.

In cases of hard, cicatricial strictures it is not easy to enter with dilators. Some of these small caliber strictures scarcely admit a sound less than 15 French, others admit only a filiform bougie. The treatment begins with small soft rubber bougies; steel sounds have to be avoided because of the danger of producing false passages. In the treatment of these strictures we have found beneficial the application of electrolysis, for with it we have accomplished in one sitting, that which we could have obtained only in weeks treatment. Mansell Moullin[13] claims that in a narrow cicatricial stricture a current of 10 to 15 milliampères has made the scar soft, and the tissues capable of distension. The action of the weak currents produces a serous exudation, and a real decomposition of the fibrous tissues removing the hydrogen with the kathode. Strong currents have to be avoided as they cause cauterization of the tissues. For ordinary work a current of from 10 to 20 M. A. is sufficient. The electrolytic sound is kept at the place of the stricture, pushing it gradually and gently forwards. After a short time it is noticed that it advances and the stricture is passed. When the sound has passed the stricture, it is left from three to five minutes, then is withdrawn. The pain accompanying this operation is so insignificant that there is no necessity of local anesthesia. The reaction is somewhat more than that which follows the introduction of an ordinary sound. The softening of the stricture is only temporary, and the use of steel sounds has to be continued to insure a permanent cure.

Levin[14] proposes short radium applications through the urethra as an adjuvant to instrumental dilatation. But a beneficial effect is denied by

Ayres[15], who in two hard strictures used a capsule of 40 mm. left in situ for thirty minutes. In one case retention developed and in the other acute urethritis. In both cases the strictures were harder than before. In obstinate and recurring strictures it is necessary to resort to urethrotomy. Internal urethrotomy in the perineal portion of the urethra is done with the dilatation urethrotome of Otis or of Maisonneuve. The cutting of the stricture is not free of any danger, as sometimes there may be hemorrhage. The benefit is temporary; after a while the tissues shrink again and the stricture needs to be dilated.

In some cases of impassable stricture external urethrotomy by perineal section is the only means to relieve the patient. We have had occasion to perform this operation, many times, with beneficial results.

When by any method the dilatation of the stricture has been obtained the second interesting part of the treatment is to keep the stricture dilated and finish the treatment. For this purpose the passing of sounds with Benequé-Guyon curve, leaving each in for three to five minutes answers the purpose. In a general way we can state, that when a stricture of the urethra has been dilated to a caliber of 25 to 30 French it can be considered a good result.

During the treatment of a stricture complications may arise which we shall only mention, epididymitis, inflammation of the stricture, and the so-called urethral fever. The use of internal urinary antiseptics such as salol, formaldehyde ammoniate, known as cystogen, antiseptin or uretropin, will clear the urine and will prevent septic fever. Before and after the dilatation an irrigation with a mild solution of biborate of sodium or of permanganate of potassium will diminish the danger of epididymitis.

The last remedy to save trouble is the hands of the surgeon, thorough sterilization, and from beginning to the end, gentleness.

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NOTES ON URETHRAL STRICTURES.

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A stricture of the urethra is a diminuation in its caliber due to a deposit of fibrous tissue caused by inflammation or injury of the wall of the urethra.

There may be sufficient encroachment on the canal by urethral, peri-urethral, or prostatic inflammation or abscess to form an obstruction somewhat similar to stricture but these conditions should not be classed as urethral stricture.

There is a congenital stricture not included in the above; it is less frequently observed and is a narrowness or normal tissue rather than fibrous.

CLASSIFICATION.

Strictures are subdivided into many classifications, according to size, degree of organization, mode of origin, caliber, characteristics in regard to treatment, complications present, etc. Some of these classifications are of practical value, while others are of little importance.

1. The congenital stricture does not usually respond well to gradual dilitation, but gives nearly perfect results when properly incised as there is not left a circular mass or ring of scar tissue to recontract.
2. Gonorrheal strictures.
3. Strictures due to traumatism.
4. Strictures due to introduction into the urethra of strong chemical agents for prophylaxis and treatment of gonorrhea.

Strictures of the urethra also are classed as passable and impasssable. This, however, often depends as much upon the surgeon and the instruments available as upon the stricture.

Urine can nearly always pass through even the tightest strictures.

Inflammation of various kinds often complicates urethral strictures as do many bladder and kidney affections.

SYMPTOMS AND DIAGNOSIS.

There is an infinite variety and combination of symptoms which vary from obstruction to the flow of urine so definite that the patient reports with the statements that he has a stricture and wants treatment for it, to the type so obscure that the surgeon

may fail to recognize the stricture as the cause of symptoms which are altogether misleading.

Among the most frequent symptoms are: a smaller stream than normal, a persistent urethral discharge and irritation slight in character and perhaps seen only in the mornings, and sexual disturbances such as premature emissions and a lack of sexual vigor.

The suspicions of stricture may be confirmed by finding a point of narrowness with an acorn-shaped bougie.

TREATMENT.

It is generally admitted that the best method of treatment is by *gradual dilatation* with sounds and the Kollmann dilator until the urethra has been dilated to a size considerably larger than normal in order to allow for the contraction that will follow later. The dilatations may be given with intervals of one to five days according to the reaction which follows. As a rule, the urethra should not be dilated again until the irritation of the previous treatment has subsided.

In the treatment by gradual dilatation, emphasis should be placed on *gradual,* because overdilatation at any one time is undesirable for the obvious reason that if the damage to the constriction is gross or massive, it will be repaired by scar tissue and thus the stricture ultimately will be made worse. The object in dilating the constriction is to cause a necrosis of the most constricting fibers by damage so slight that it will not be repaired by scar tissue but will undergo absorption, thereby lessening the constriction.

In all urethral work it is of the utmost importance to use gentleness—always gentleness. Painstaking work is rewarded by good results while haste and carelessness may be attended by serious dangers.

Internal Urethrotomy: For various reasons it becomes necessary or advisable to perform an internal urethrotomy which is the plan to follow in incising strictures in the anterior urethra. Too much hemorrhage is likely to follow if this operation is done in the deep urethra, the external perineal urethrotomy is the operation of choice in this region.

The following are some of the reasons for incising urethral strictures; resilient ones which quickly recontract after dilatations; those which for other reasons do not respond in a reasonable time to adequate dilatations; strictures too extensive or too tight for gradual dilatation; and occasionally where the patient lives in a place too remote from a surgeon to employ the dilating method.

External Perineal Urethotomy is indicated in tight or resilient strictures of the deeper part of the urethra, that is, in the region near the external sphincter; furthermore, this operation is required where there is complete or nearly complete obstruction of the urine; for infiltration of urine and where there is stone in the bladder complicating the stricture.

It is of great importance to pass an instrument or a filiform through the urethra into the bladder to act as a guide in incising the constriction. A painstaking effort should therefore be made in all instances to pass something through the urethra as a guide for it greatly facilitates the operation; this effort should be made before the anesthesia is started. Finally, if nothing can be introduced, the patient is anesthetized and a further, though short, effort made to pass an instrument. If this fails, the perineal incision is made down to the point of the instrument in the deep urethra, then a probe-pointed gorget, or some such instrument, is carefully passed through the stricture into the bladder. This is often difficult, or perhaps impossible. When unable to pass an instrument, we have recourse to one of two methods.

First: to bore through the stricture with the forefinger until the stricture is passed. This plan has been recently advocated by Livermore and we have found it of distinct value.

Second: rather than waste too much time in searching for the urethra at the stricture and back of it, especially if there is abscess or urinary infiltration, a suprapublic cystotomy should be performed and the dilated part of the urethra back of the stricture found by retrograde sounding. This method is preferable for the average surgeon who has not had extensive experience in dealing with these conditions.

A large catheter is fixed in the urethra after external perineal urethrotomy and allowed to remain in the urethra for ten days.

The bladder is irrigated daily through the catheter with a saturated solution of boric acid.

Subsequent dilatation should be followed as in dealing with ordinary dilatable strictures.

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Hyperesthesia of the Neck of the Female Bladder.

Cauterization of the neck of the bladder with silver nitrate is indicated only in a few intractable cases and should be considered only a *dernier ressort.*—Charles G. Foote in *The Urologic and Cutaneous Review.*

URINARY EXTRAVASATION.

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The truly urgent character of urinary extravasation marked by a rapidly advancing phlegmonos cellulitis, makes it one of the gravest conditions met in practice and emphasizes the need for a more generally distributed knowledge concerning its best management. Practically every case of urinary extravasation of this serious type may be brought to a successful end, provided prompt measures are applied. They must be operated upon as quickly as possible and exposed to a minimum of shock. Platitudinous as this remark may seem, I make it in the full memory of several cases I have known to be subjected to varying periods of "watchful waiting"—with grave result to the victims.

To the term "urinary extravasation" exception is taken by some urologists. Thomson Walker, to mention one author, says it is a misnomer as generally used. If one considers that the term means the free escape of the urine out into the tissues by reason of a suddenly acquired defect in the urethral wall, or, in other words, the emptying of the entire bladder contents into the perineal, scrotal and external abdominal tissues, then the term is improper. However, some urine does infiltrate the tissues more less related to the urethra, and thus for all practical purposes, we are justified in continuing the use of the expression. Furthermore, it has the advantage of wide and long established usage. Any one who has ever cut into the swollen, edematous areas subjected to a fulminating cellulitis in consequence of a leaky urethra, will not soon forget the heavy, urinous odor of the escaping fluid.

The typical case that comes into the large urological services gives a history that parallels the following: The patient, a derelict, has had innumerable attacks of gonorrhea. If a negro, he has given them but slight heed. For some time he has had urinary difficulty. At different times he has noticed that the stream was small and the act occupied a longer period than formerly. Once or twice it stopped entirely, relief being secured by the passing of instruments. Within the preceding twelve or twenty-four hours, while straining to pass water, the patient felt something give way and a slight degree of relief was experienced. Then no more urine would come, or possibly a small quantity through the encouragement of much straining, was passed. The perineum became swollen and painful, the scrotum rapidly increased in size, and finally the patient began to realize that something serious had occurred along the lower urinary tract.

After a further wait, during which efforts were made to introduce catheters, the man comes into the hospital, the cellulitis much advanced in grade and extent, the urethal canal badly lacerated and the patient in a condition of sepsis. His temperature is high, the pulse between 120 and 140, the mouth dry, and complaint of great thirst. It must be remembered that the urinary function has been put to a strain for many months and, under the new burden, the kidneys are reacting badly.

Since the majority of tight strictures are located in the bulbous portion of the urethra, it follows that in most cases of extravasation due to stricture, the urethral tear is in the same portion of the canal. The usual route taken by the urine in these cases indicates the frequency of the tear in the bulbous portion. The anterior layer of the triangular ligament guards against access to the deeper structures in the perineum and pelvis and the escaping urine seeks the superficial perineal structures. From the perineum the extravasation extends to the scrotum, guided in this direction by the deep layer of Colles' fascia. Since this layer of Colles' fascia is not attached between the pubic spine and the symphysis, the spreading extravasation rapidly passes through this open space to reach the abdominal wall. If the urethral tear be elsewhere than in the bulbous portion then the extravasation pursues a course determined by the anatomical relation of the site of the tear. If posterior to the deep layer of the triangular ligament the condition is fraught with the most serious danger by reason of the course the extravasated urine takes. The resulting purulent infection involves the perivesical and perirectal structures and may rupture into the peritoneum with a fatal issue practically inevitable. In a rupture of the canal at a point between the two layers of the triangular ligament, the escaping urine, soon augmented by the quickly forming pus, becomes confined between the layers until rupture in some direction takes place. This may be toward the ischio-rectal fossae or into the perineum, in which latter event the picture takes on the characteristics of extravasation through the bulbous portion, provided the patient lives long enough for the occurrence of this sequence of events.

In most of these cases a cystitis has been present for months, with probably a secondary infection of the kidneys, and, in consequence, the urine is foul and of a highly infectious character. Hence, the fulminating nature of the infection and the prompt appearance of symptoms of general sepsis, which are notable characteristics of urinary extravasation.

The appearance and condition of the involved tissues indicate the virulence of the infectious process and the period of time which has elapsed since the extravasation began. In an advanced case the scrotum is greatly swollen, gangrenous and filled with a purulent fluid. The abdominal tissues are markedly infiltrated, boggy and crackle upon pressure. It is generally held that if the penis shows a grangenous spot, a fatal issue may be expected.

In cases of a chronic character, marked by abscesses and fistulae in the perineum, there has been but slight leakage. This leakage has taken place into glandular structures, the process has been slow and the resulting abscess has finally pointed or ruptured in the perineum or ischiorectal region. Ordinarly the proper treatment in such cases is to cut the stricture, preferably doing a combined internal and external urethrotomy, and then open the sinuses to the urethra, curetting and packing the tracts. However, in some instances, successful results follow dilatation of the stricture and the injection of iodine or peroxide of hydrogen into the sinuses.

But in the typical case of extravasation with sepsis present and urinary failure impending, one must give thought to but positive and heroic measures.

The prime purpose is to establish adequate drainage at the least expense to the patient's rapidly dwindling strength. If an instrument can be introduced through the damaged urethra into the bladder, this purpose is easily effected. But it must be remembered that in the average case, urinary extravasation is not a condition that permits of tedious and nicely exact surgery as would be necessitated by attempting to make a perineal section without a guide in the urethra. The tissues are altered and identification of the usual landmarks is quite difficult.

Unless a metal guide can be easily passed through the strictured region, the best plan is to attempt the passage of a Maisonneuve filiform guide. If this is successfully passed in a short trial with the patient under an anesthetic, then it is followed by the Maisonneuve urethrotome and the stricture divided. The urethrotome is withdrawn and a large sound introduced. The patient is now put in the lithotomy position and a perineal section made. Through this latter wound a gorget is slipped along the canal to the bladder. Using this latter instrument as a guide, a quarter-inch stiff drainage tube or a large catheter, fenestrated and the distal end cut off, is passed into the bladder. This provides excellent drainage and also serves to stop the hemorrhage resulting from the urethrotomy. In the event that there are old fistulous tracts, these are laid open to center at the perineal wound. They are curetted and all necrotic tissue removed. The large gaping wound resulting is packed with gauze and the edges loosely brought together. Following this procedure the infiltrated scrotal and abdominal areas are widely opened by means of multiple incisions and dressed with hot bichloride of mercury packs.

The perineal tube is removed on the fifth day and the wound permitted to granulate. Beginning on the tenth day sounds of increasing size should be passed throught the urethra. A canal that easily takes a 26 French sound may be considered of ample size to provide necessary drainage. From now on the perineal wound begins to close and, provided the urethra is kept open, prompt healing results. The areas into which the urine has extravasated are sufficiently drained through multiple incisions and there is no need for tubes.

In passing, I want to make a vigorous protest against the practice of aspirating the bladder suprapubically. To cut down upon this organ is a safer and far more logical surgical procedure than blindly to stick a trocar into it. One never knows just how far the peritoneum dips toward the pubes. Some months ago I saw a case in point. The patient had been suffering from acute retention. Unable to introduce an instrument through the urethra, the attending physician aspirated the bladder. The peritoneum, dipping unusually low, was injured. Urinary seepage took place, septic peritonitis followed, and the patient died. The simplicity of cystotomy under local anesthesia should always obviate this blind procedure.

Those cases of urinary extravasation in which the introduction of an instrument through the urethra is impossible, and we are now approaching traumatic rupture with complete separation of the two urethral ends, bring the surgeon close to the point when he must choose between suprapubic

cystotomy with retrograde catheterization, and a tedious search for the canal through a badly damaged and much altered perineum. Some surgeons maintain that the employment of retrograde catheterization is a confession of the lack of one's ability to find the urethra through perineal section and, hence, is a procedure of last resort. This point, however, is open to argument. In those cases of urinary extravasation following stricture in which no instrument can be passed through the canal into the bladder, to find the urethra through a perineal incision will require a long, tedious search. The condition of these patients is such as to demand a minimum of anesthesia and surgical shock. Regardless of one's knowledge of perineal anatomy and confidence quickly to find the urethra, in cases such as these the wiser surgery, in all probability, is to employ retrograde catheterization, followed by perineal section, cutting down upon the guide introduced through the cystotomy wound. Cases of this character are best drained both suprapubically and perineally, the perineal tube being removed first, on about the fifth day, suprapubic drainage through a tube being continued for another five days. This mode of drainage permits of softening of the urethral and periurethral sclerosis and secures quicker healing of the urethral wound with reduced possibility of early re-contraction of the stricture. An important point in these cases is to make sure of an open canal anterior to the urethral opening. The perineal wound will not heal readily if tight places anterior to the ruptured point are left without proper attention. They must be dilated or divided.

In complete or practically complete traumatic rupture of the urethra the question of retrograde catheterization becomes even less debatable.

Suprapubic cystotomy with the excellent drainage thus afforded, possesses certain advantages that compensate in large measure for the added surgery and lengthened convalescence. Drainage exclusively through the urethra and perineum does not secure for the damaged parts the rest and cleanliness that suprapubic drainage does. The latter puts the urethra and infiltrated tissues at rest, promotes more prompt resolution of the inflammatory process and encourages softening of the cicatricial deposits in the case of stricture. In traumatic rupture with suture of the divided urethral ends, a cleaner and firmer union results if the urine be diverted suprapubically. The logic of diverting the urine becomes all the more obvious when one remembers that in a goodly portion of cases of stricture, a cystitis is present with a highly infectious urine. This method of drainage insures but a minimum of infectious urine trickling into the damaged urethra and stagnating on freshly cut surfaces with greatly reduced cicatrizing power, which, unquestionably, is an advantage of no mean importance. It may be an advantage of sufficient importance to compare well in weight with the equally important disadvantages of opening the bladder suprapubically.

In removing a sclerotic segment of urethra, one of the essentials required to guard against infection and promote primary union with a reduced possibility of stricture formation at the site of resection, is a preliminary suprapubic diversion of the urine. Since an attempt to secure these purposes is an accepted procedure in a deliberately inflicted severance of the urethra, why also is it not just as logical a step in the repair of an accidentally ruptured canal, in which practically the same conditions and purposes obtain?

ILLUSTRATIVE CASE.

A recent case that came into my service was that of a man aged 21 years. He fell from a height of a few feet, landing astraddle a box. For some 12 hours he was treated very conservatively. Unable to urinate, the passage of a catheter was attempted. The result of this procedure was not clear. Forty-eight hours after the accident the patient entered the hospital. A small quantity of bloody urine could be passed. The bladder was distended almost to the umbilicus. The perineum was contused and very much swollen. A condition of extravasation was present. It was impossible to introduce any sort of an instrument through the urethra into the bladder. Without further delay the bladder was opened suprapubically and a sound passed through the bladder into the urethra. The patient was put into the lithotomy position. With the sound as a guide the urethra was quickly exposed and the point of rupture located. A catheter was now introduced through the penile portion of the canal, grasped as it presented at the ruptured site, and passed on into the bladder. The urethra was moulded around this catheter and the torn edges brought into loose apposition with a few catgut sutures. The bladder was drained with a large tube above the pubes. The catheter over which the ruptured urethra was moulded, was tied in for a few days, then withdrawn. The suprapubic drain was continued for ten days, after which the wound was permitted to close over. Urine soon began coming through the canal. After fourteen days instruments were passed in increasing size until a French 26 sound could be passed. This case shows a marked tendency to stricture formation. For several weeks a fistula in the perineum persisted but with dilatations it has manifested a tendency toward complete closure, only occasionally showing a discharge of urine. Beyond this, the patient has no urinary symptoms.

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WALTER M. BRICKNER, M.D., F.A.C.S., Editor.

NEW YORK, DECEMBER, 1920.

UROLOGY.

From the standpoint of diagnosis, at least, there is no branch of medicine more fascinating than urology, since it presents such nice problems for solution and such nice methods for their determination—endoscopy, cystoscopy, ureter catheterization, microscopy, bacteriology, roentgenography, and biochemical tests of urine and blood.

The urethroscope and the cystoscope expose to the eye the lower urinary tract from the ureters to the meatus urethrae. The ureter catheter permits sounding of these two channels, the separate collection of urine and urinary admixtures from each kidney, the irrigation of the kidney pelves; combined in its employment with roentgenography, it makes it possible to outline the calyces, pelvis and ureter, and often thus to present a picture by which a lesion of the kidney may be visualized, or congenital anomalies—horse-shoe, misplaced- and fused-kidneys, duplicated ureter, etc.—demonstrated. By these means the source and character of a hematuria can often be clearly determined; while, by a combination of these and other diagnostic inquiries, it can, in the more obscure cases, be fairly postulated. In this connection Hyman's contribution in this issue of the JOURNAL will be found interesting and informative.

A relatively small, but by no means inconsiderable percentage of urinary calculi fails to cast a shadow in the roentgenogram; but the number of these that escapes detection is greatly reduced by the exploring cystoscope, the wax-tipped catheter and the search for blood cells in the segregated urines. The causes of urinary lithiasis—predisposing and immediate, and the means to prevent its recurrence, are problems that have thus far not emerged from the domain of speculation.

A surgical affection of a kidney having been discovered, it is of the greatest importance to determine also the functional capacity of that kidney and of its mate. Here we must learn the nitrogen output of each kidney (from the segregated urines); and their excretory activities can be further estimated by injections of indigo-carmine and of phenolsulphonephthalein. But these tests, we have found, are not absolute, for the presence of disease in one kidney may, reflexly, inhibit the function of the opposite, and otherwise healthy, kidney. Nor is it enough to estimate the kidney function by these or similar methods. It is also necessary to learn the extent, if any, of renal insufficiency by chemical analysis of the blood. The importance of this, the urologic problems on which it bears, and its prognostic significance are set forth in Prof. Legueu's admirable address in this issue of the JOURNAL. It is in those cases in which both kidneys are seriously diseased, or in which both harbor menacing calculi, that the surgeon's judgment is put to a supreme test.

The study of kidney function, by blood chemistry and by dye-excretion observations, is important in "medical" as well as in surgical affections, and we may expect that advancements will be made no less by internists and physiologists than by urologists.

In contrast with the brilliant progress in urologic surgery in the past fifteen years, or in the diagnosis and treatment of syphilis during that period, the therapeutics of the most common infection of the lower urinary tract—gonorrhea, has advanced but little indeed. This disease is still treated by injections or irrigations with solutions of silver salts or of potassium permanganate or, more recently, of acriflavine—a product of war wound antisepsis. In *The N. Y. Medical Journal,* March 1, 1919, Frederic Mason, of New York, published a note on the treatment of gonorrhea by the injections of agents that penetrate and fix the cytoplasm of the gonococcus without injuring the host, the first agent being a "sensitizer" and the second a "developer." The rationale and technic of this procedure he further describes in this issue of the JOURNAL. Similarly, Young, White and Schwartz evolved "mercurochrome" (a mercury compound

of fluorescein) as a bactericide (*Journal of the A. M. A.*, November 15, 1919). Both of these injection means have given favorable results as reported by their authors. The difficulty that confronts all bactericidal treatment by irrigation or injection is that the organisms they are intended to reach are not on the surface of the urethra but in its recesses. The specific gonococcide that can be brought to act in these recesses has not yet been found.

ALL-AMERICA CONFERENCE ON VENEREAL DISEASES.

Of interest to urologists and, indeed, to the profession generally, is the Conference on Veneral Diseases meeting in Washington, D. C., December 6th to 11th, under the auspices of the U. S. Interdepartmental Social Hygiene Board, U. S. Public Health Service, American Red Cross, and American Hygiene Association, with Prof. Wm. H. Welch of Johns Hopkins as president. The conference will discuss the problems of medical control, involved in both diagnosis and treatment, of administrative control, of educational propaganda, law enforcement and social influences.

Surgical Suggestions

In infants and small children a large abdominal tumor is most often a sarcoma of the kidney.

If a prostatic calculus occupies a urethral pouch, it is important to destroy that pocket, lest calculi re-form in it.

The more nearly completely a kidney is disorganized by disease the more safely can it be removed, so far as the functional value of the other kidney is concerned.

If pus containing no gonococci is found in the prostatic fluid of an individual who has for years been free of any local infection a calculous prostatitis should be suspected.

A stone-bearing prostate may be found upon rectal palpation of normal size and contour and not unusually sensitive; or it may be enlarged, nodular or lumpy, and exquisitely tender. "Lumpiness" and great tenderness are very suggestive, but not diagnostic of stones, since they may arise from other conditions. If crepitation of the concretions is felt by the examining finger this *is* diagnostic.

A single stone in the urethra that is not known to have escaped from the bladder should suggest an inquiry into the possibility of more stones in the prostate.

When prostatic calculi have formed, inflammatory changes take place in the gland—fibrous tissue growth and, sometimes, suppuration. Clinically, therefore, as well as pathologically, we must have in mind the conception not merely of calculi in the prostate but of a *calculous prostatitis*.

A single stone or a small group of stones in the prostate gland should be removed by a perineal prostatotomy. The removal of multiple, scattered stones requires the removal also of much of the gland itself—an incomplete prostatectomy. Since this will not leave merely a collapsible capsule, as after shelling out the adenomatous prostate, the perineal is here preferable to the suprapubic route.

Progress in Surgery

Selections from Recent Urologic Literature.

Edward Bleier, M.D., Abstract Editor.

Ointment Medication of the Urethra. IRVIN S. KOLL, Chicago. *The Urologic and Cutaneous Review*, September, 1920.

The method employed by the author has been in use seven years and has given uniformly good results. The ointment is put up in collapsible metal tubes, the end of which is shaped like the tip of a urethral syringe, a key is turned at the opposite end which forces the ointment into the urethra.

Albargin, one per cent. in strength, is the drug used for gonorrheal infections. Oxycyanide of mercury, one to two thousand in staphylococcus urethritis and the solution of aluminum acetate one per cent. if the offending organism is the colon bacillus. The astringent preparations are zinc sulphate one and one-half per cent. with one-half per cent. of alum copper sulphate two per cent. is also occasionally prescribed in this form.

In acute gonorrheal urethritis the albargin ointment is used three times daily and each injection retained fifteen minutes.

In addition to the therapeutic efficacy of these tubes, they have the advantage of cleanliness and ease of application and in general are very satisfactory to the patient.

The Diagnosis of Inflammations of the Male Urethra. ABR. L. WOLBARST, New York. *New York Medical Journal*, October 9, 1920.

Wolbarst lays particular emphasis on the necessity for accurate diagnoses in inflammations of the urethra, with special reference to the various etiological factors. In the acute cases it is most important to determine the specificity of the lesion. The micrococcus catarrhalis is a frequent cause of urethral discharge. Smears or cultures will readily make the diagnosis. Bacillus coli may occasionally cause a urethral discharge, and is probably associated with suppuration in the prostate or epididymis. Other rare causes are the pyogenic organisms of the mouth, syphilitic cancer or chancroid in the region of the urethral mucous membrane. In gonococcal urethritis the diagnosis is usually made clinically, but it should always be veri-

fied by smears of the pus. In nearly all cases a typical triad of symptoms, angry meatus, profuse discharge, and purulent urine are present. The absence of any one of these should raise suspicion as to the etiology.

In chronic urethritis the problem is more difficult. The problem here is to locate the source and the character of the lesion. The usual causes are stricture, folliculitis, prostatitis and vesicultits. Urethroscopy is absolutely essential for accurate diagnoses in these conditions.

In chronic inflammation, stricture, folliculitis, prostatitis, vesiculitis, and colliculitis are predominating causative factors. The diagnosis must be arrived at through precise scientific measures, not through guesswork.

The Treatment of Gonorrhea of the Male Urethra. EDWARD L. KEYES, JR., New York. *Journal of the American Medical Association*, November 13, 1920.

Inasmuch as the essential pathologic lesion of the chronically inflamed urethra is an infiltration of its submucosa, the essential treatment of chronic urethritis, according to Keyes, is dilatation which shall be made to simulate massage as nearly as possible—dilatation applied both to the anterior and to the posterior urethra so far as the inflammation affects both portions of the canal. Dilatation should not cause bleeding. for bleeding is evidence of laceration, laceration is the occasion of infiltration, and infiltration is the lesion that we are seeking to relieve. Dilatation should not attempt to stretch scar tissue, because scar tissue cannot be stretched. The anterior urethra may profitably be dilated to from 28 to 32 F.; the posterior urethra (by means of the Kollman dilator) to from 33 to 38 F The intervals between treatments should be from five to ten days. The application of injections and irrigations, however antiseptic, to the surface of the urethral mucosa can have but little effect on its pathologic processes. A mild urethral discharge may be controlled by a mild injection, and for this purpose astringent injections of zinc sulphate and similar substances are far more efficacious than are the antiseptics. If the treatments are gentle, it is often quite as well not to introduce any antiseptics into the urethra; but when beginning with a patient, or if there is any possibility of a reaction following the treatment, an antiseptic which washes out the major number of bacteria and tends to diminish the vitality of others is worth while. Massage of the prostate and seminal vesicles is the best substitute for the processes of Nature, and has the added advantage of being conducted in a relatively calm spirit. The urethroscopic treatment of granulations in the posterior urethra by the application of chemicals is most useful in cases that resist treatment by dilatation. But the urethroscopic treatment is not to be considered one of choice to replace dilatation—dilatation is always of the essence of the treatment of chronic urethritis.

The Operative Treatment of Congenital Deformities of the Lower Urinary Tract. With Special Reference to the Formation of a Compressor Urethrae. RALPH THOMPSON, London. *The Lancet*, October 16, 1920.

The author reports five successfully treated cases. One case of epispadias, one of ectopia vesicae, and three of hypospadias. The most interesting procedure is the use of a flap of rectus muscle for the formation of a substitute compressor in the case of epispadias. The author first proved by dissection and experiment that a flap of rectus as proposed could be feasibly used for this purpose.

Detailed descriptions of the operation for epispadias, ectopia and hypospadias are given.

Spermatocele. EDWARD T. CROSSAN, Philadelphia. *Annals of Surgery*, October, 1920.

Crossan reviews the subject of spermatocele from the historical and practical standpoint. The definition accepted by the author is one which should include all types of lesions grouped under the classification, *e. g.*, spermatocele is a cyst originating in the scrotum, and which is or has been in communication with the semen-carrying system. It need not therefore always contain spermatozoa. From a review of the literature regarding the origin of the lesion, it can be said that spermatoceles arise most frequently from the vasa efferentia and vas aberrans superior, often from the sessile hydatid, and only occasionally from the vas deferens, pedunculated hydatid, and organ of Giraldes. Of the various factors that have been mentioned as the cause of this lesion, such as trauma, sexual abstemiousness, and gonorrhea, the author is inclined to favor trauma. The kind of trauma to the scrotum that produces spermatocele is not exactly known, for while trauma to the testicle is frequent, spermatocele is quite rare. The cysts may be intra or extra-vaginal. The cyst wall is made up of connective tissue fibers, with some strands of smooth muscle, while the lining consists of ciliated or cylindrical epithelium. The contents are usually milky or soapy in color. On microscopical examination they show lymphocytes, fat globules, epithelial cells, and spermatozoa, rigid or motile. The chief symptom is the swelling, although there may be pain in the testicle on excitation. On physical examination, the only symptom is the tumor, usually a globular mass sitting on top of the testicle. The only treatment is operation, removal of the cyst, or castration where the testicle is atrophied.

A Consideration of the Varicocele Operation and the Avoidance of the Post-operative Induration. PENN. G. SKILLERN, Philadelphia. *Annals of Surgery*, October, 1920.

The undesirable sequel of the operation for the cure of varicocele, referred to by the author is the column of induration which forms. This usually extends from the testicle upwards to the external inguinal ring. This often persists for several weeks and is more annoying than the condition for which the operataion was done. The causes of this column are: (1) Limited resection of veins with end-to-end suture of the stumps: this results in stagation of blood in the vessels, with a lump at the site of the stumps: (2) failure to obliterate the dead spaces established by dissection of the fascial layers: these spaces furnish room for the outpouring of blood and juices after operation: (3) irritation of the vas deferens from rough manipulation; the vas in very sensitive to trauma to which it reacts by swelling to several times its original size.

The ideal varicocele operation must remove all the veins involved. No dead spaces must be left; these are usually caused by edge-to-edge apposition of the fascial layers or no suturing of the layers at all. There must be no trauma to the vas. The author describes in detail the method used which avoids the complication referred to.

The essential features of his operation are: Complete removal of the affected veins throughout their entire length from testis to internal ring. The cremaster muscle is sutured down snugly over the vas, and if desired, the muscle may be slightly shortened by transverse sutures to raise up the testicle. The scrotum should not be shortened by resection. The external oblique and Scarpa's fascia are closed as separate layers, and the latter tacked down to the former to obliterate any possible dead space. The cut edges of Camper's fascia are similarly sutured. After following this technic, the author finds that the undesirable column of induration does not occur.

Orchitis From Mumps: The Need of Conserving the Testes by Incision of the Tunica Albuginea. EDGAR G. BALLENGER and OMAR F. ELDER, Atlanta, Ga., *Journal of the American Medical Association*, November 6, 1920.

It is asserted by Ballenger and Elder that the present method of treating orchitis caused by mumps is inadequate. This is shown by the large number of atrophied testes observed. The rational plan of procedure, which they have adopted, is to incise the tunica albuginea and relieve the pressure, and at the same time allow the escape of some of the toxic substances produced by the organisms which cause mumps. This must be done early in the disease before the necrotic process has become established.

The Diagnosis of Prostatism. FRANK HINMAN, San Francisco. *Northwest Medicine*, September, 1920.

Hinman discusses the symptom-complex termed "prostatism" and outlines the method of procedure in differential diagnosis of the pathological conditions causing it. He presents several outline tables, showing the causes and procedure for complete examination and differentiation.

Prostatism is the term applied to the symptom-complex caused by hyperplasia, cancer of the neck of the prostate, or contracture of the vesical neck. The direct cause of symptoms is obstruction or urination. Frequency of urination usually with difficulty is the common clinical evidence of obstruction, but this symptom is very frequently associated with other conditions than prostatism. One of the most cnaracteristic symptoms of prostatism is the gradually increasing inability to completely empty the bladder which is usually coincidental with progression in the symptoms of frequency and difficulty. Other conditions also lead to residual urine, and a careful diagnosis requires accurate and systematic, clinical, chemical, microscopical, and cystoscopic study.

Tuberculosis and chronic inflammatory changes produce fibrous infiltration which simulates the stony hardness of the ordinary cancer, and stones in the prostate may be of such size and position as to be mistaken for cancer. Cancer commonly starts in the posterior lobe and spreads by extension along the ducts, or by direct cell invasion, so as to involve first the seminal vesicles and base of the bladder. The mucous membrance of the urethra and bladder are quite resistant, nor does the rectum ever become involved except rarely in very late stages. Blood metastases are usually late. Tuberculosis is characteristically nodular on palpation and rarely primary in the prostate. The commonest genital type is unilateral tuberculous epididymitis, between the ages of 20 and 40, involving primarily the globus minor, and secondarily the vas and seminal vesicle. In the later stages bilateral lesions are found. Rarely would the differentiation of cancer and genital tuberculosis lead to much confusion.

Chronic fibrous inflammatory infiltration may at times be differentiated with difficulty. Chronic inflammations can give extreme hardness, and doubtless everyone who sees many prostatics has mistaken these cases for cancer and vice versa. Prostatic stones may ordinarily be demonstrated by *x*-ray and in all suspicious cases this method of examination should not be neglected.

The diagnosis of prostatic cancer is made almost wholly by the findings upon rectal palpations. This limitation of method in arriving at a diagnosis and the late development of symptoms indicative of cancer that would arouse clinical suspicions renders early recognition of the lesion difficult and in point of fact quite exceptional. The stony hardness is so characteristic that recognition in the late stages after symptoms have developed is relatively simple.

The size and shape of the prostatic surface outlined per rectum is an important step in the diagnosis of hyperplasia. A normal gland has the general shape of a horse-shoe chestnut with a well-marked furrow, a pronounced notch and rounded lateral lobes with sulci at the sides between each lobe and the rectal wall. In hyperplasia there is at first an obliteration of the furrow, then of the notch and finally general enlargement of the whole surface, so that the lateral sulci become deeper and deeper and the upper border higher and higher until in the larger types the examining finger cannot reach the upper limits of the enlarged gland. In hyperplasia definite elasticity is the rule; sometimes the consistency is soft and boggy. There may be types of intravesical enlargement, in which the changes noted per rectum are indefinite. Such types of enlargement can only be definitely diagnosed upon cystoscopy. Often these types produce the more troublesome obstructions. Negative or indefinite rectal findings, therefore, do not exclude the possibility of the presence of pathogenic hyperplasia.

In contracture of the vesical neck rectal palpation gives negative findings except, perhaps, for the ordinary evidence of chronic prostatis and vesiculitis. The presence of the contracture is intimated in no way by palpation. But negative rectal findings in the presence of typical prostatism and residual urine have a tremendous significance. Such a condition may occur with intravesical hyperplasia without enlargement per rectum, with spinal cord lesions and with contracture of the vesical neck. In the cases of spinal cord disease relaxation of the anal sphincter is ordinarily coincident with that of the internal vesical sphincter. The three conditions are definitely differentiated by cystoscopy. Before cystoscopy, however, is undertaken, a good impression of the probable cause of the symptoms should have been made by the course of the routine procedure of examination as just outlined.

The Intravesical Treatment of Benign Tumors of the Bladder by Chemo-coagulation. EUGEN JOSEPH, Berlin. *The Urological and Cutaneous Review*, September, 1920.

Joseph has found Beer's method of thermo-coagulation (fulguration) perfectly satisfactory as a method of treatment in benign papillomata of the bladder, especially when the tumors are small. The treatment is convenient, quick and exact. In very large papillomata, however, the treatment is too slow and requires too long a period of time, as only a small portion of the growth can be attacked at each sitting. Operation is condemned.

For this type of case, Joseph uses chemo-coagulation by means of the direct application of trichloracetic acid. The crystals are warmed, and they dissolve readily in their own water of crystallization. A few drops of glycerin are added to prevent re-crystallization. The injection syringe should be slightly warmed.

The catheter should be about 25 cm. long and of small diameter. By aid of the cystoscope the ureteral catheter is brought in contact with the growth, so that the catheter opening is brought directly over the tumor in order that when the acid is injected it should fall over it from above. When the cathether is properly placed the assistant is directed to inject the acid slowly by means of the attached glass syringe. When the acid comes in contact with the growth it turns it snow-white, so that it soon assumes a frozen appearance. Care should be taken that none of the acid comes in contact with the surrounding mucous membrane. Fortunately, however, the bladder mucous membrane is quite more resistant to the acid than the growth itself, and should any of the acid damage it, it would heal up in about three weeks. But any damage to the mucosa can be avoided by attention to the following rules:

(1) The beginner should handle large papillomata only where treatment by thermo-coagulation is too inconvenient and slow. In such a case it would be easy to spray the acid on the growth from above without getting any of it on the surrounding mucous membrane. If, as a result of the chemo-coagulation, the largest part of the growth is destroyed and only a small piece or pedicle is left, this remaining part may be treated by thermo-coagulation not for the purpose of fastening the cure, but for preventing the acid from damaging any of the adjacent mucous membrane.

(2) In the treatment of small papillomata by chemo-coagulation, great care is essential. The acid must be injected very carefully, not more than a few drops to come in contact with the growth.

(3) The period between treatments, during which time there tends to be an inflammatory reaction surrounding the growth, should be three or four weeks, until every sign of the inflammatory reaction is gone.

(4) Chemo-coagulation is only applicable to soft papillomata. The solid, nodular growths are influenced but slightly. It is true that they will also show some whitish necrosis, but the action is not deep and does

not affect the growth in its depth of origin. In these growths chemo-coagulation is of signal service in preventing or treating hemorrhage and secretion. It works in the same way as zinc chloride application in inoperable uterine carcinoma. Solid growths that neither bleed nor secrete I consider useful for treatment with trichloracetic acid, because the action is not deep enough to destroy the tumor and it produces a severe inflammatory reaction which causes suffering to the patient.

After chemo-coagulation the bladder should be at once emptied and irrigated.

Fulguration in Tuberculous Cystitis. (*De L'Etincelage dans la Tuberculose Vesicale.*) A. PARISI. *Journal d'Urologie,* Vol. 9, No. 5-6.

In a very comprehensive article, Parisi reviews the subject of tuberculous cystitis, laying particular emphasis on the cases in which the distressing bladder symptoms persist, after nephrectomy for tuberculosis of the kidney. The statistics on this subject do not agree, but it can be definitely stated that a good percentage of cases do not clear up symptomatically after nephrectomy. In those cases in which bladder symptoms do disappear, it is probable that the symptoms were reflex, the so-called "irritable bladder" encountered in renal tuberculosis. It is doubtful whether true tuberculous lesions of the bladder will clear up after removal of a tuberculous kidney. The main factors in these rebellious cases are, partial removal or failure to remove a tuberculous ureter, tuberculosis in the second kidney. The symptoms and cystoscopic findings are minutely described. Many varied pictures may be obtained. There may be ulcerations, vegetations, diphtheritic membranes, or edematous bullae. The danger of leaving a residual cystitis untreated, in addition to keeping up the symptoms indefinitely is, ascending infection of the remaining kidney. The author describes in detail the technique of fulguration in these cases with a complete description of the results in 21 cases.

His conclusions are:

1. The method of fulguration is a cystoscopic procedure, which is applicable to all cases of residual cystitis after nephrectomy for tuberculous.

2. Fulguration is applied at long intervals, requiring only a few séances. This is quite contrary to other methods of treatment which require frequent intra-vesical treatments which are quite distasteful to the patient. The antiseptic value of the high frequency adds to the other advantages of the treatment.

3. The precise indication for fulguration is the type of cystitis characterized by the ulcerous lesions. It is in these cases that the highest percentage of cures are obtained. The treatment may be used in addition in other cases with crusting or fungoi formation.

4. High tension current is best adapted for this work, although low tension (Arsonval type) may be used. The entire surface of the ulcer or other lesion should be treated. The treatment is easily controlled by the cystoscope, noting the blanching at the point treated. Treatments should be about fifteen days apart. Cocaine, 4 per cent, is used as an intra-vesical anesthetic in most cases.

5. There may be a severe reaction after the treatments, manifested by polyuria and violent pain, but this rarely lasts more than two or three days. There have been no accidents with the treatment, except one case of nocturnal incontinence. In 21 cases there were 10 cures, 9 improved, and 2 unimproved.

6. Fulguration with the high frequency current should have a definite place in surgical therapy. It should be applied in the residual or rebellious cases following nephrectomy. It might be possible that treatment applied to the ureter in residual ureteral tuberculosis may accomplish similar results.

The Treatment of Calculi Impacted in the Pelvic Portion of the Ureter. FRANK KIDD, London. *British Medical Journal,* July 30, 1920.

Kidd outlines the methods of diagnosis, and the procedure to be followed in these cases.

Before a decision is made that an *x*-ray shadow in the pelvis is due to a stone in the ureter it is absolutely essential to employ special methods of differentiation. One method is to pass up the ureter a bougie opague to the *x*-rays and take another *x*-ray picture. In many cases the shadow of the tip of the bougie can be seen touching the doubtful shadow, but sometimes the evidence thus obtained is not conclusive. Another method is to inject 20 per cent. colloid silver into the ureter through an ordinary ureteric catheter and then to take an *x*-ray picture. If a stone is present there will be seen the shadow of a dilated ureter above the stone shadow, which will appear to be lying at the site of a narrowed portion of the ureter; such evidence, if it can be obtained, is conclusive that the doubtful shadow is cast by a stone. Another method is to pass wax-tipped bougies up the ureter, when scratches can be detected on the wax.

The practical point remains that no operation should be undertaken on the ureter for the removal of stone until supplementary *x*-ray methods have been employed in addition to ordinary *x*-ray methods.

Conservative methods should always be employed before open operation is resorted to.

Kidd describes the following methods for coaxing a stone down the ureter:

In the first place the patient should be flooded with diuretic waters, and should take regularly every day urinary antiseptics by the mouth with the object of preventing bacterial infection if it has not already arisen. A cystoscope should be passed and various methods of cystoscopic extraction tried. These methods are, briefly, as follows:

1. Injection of sterile paroleine through a ureteric catheter around the stone may induce a stone to pass a few days later. In 4 cases Kidd obtained success in this manner.

2. Recently it has been suggested by Geraghty and by Walther to inject 5 c.cm. of a 4 per cent. solution of papaverine sulphate locally into the ureter through a catheter. This alkaloid causes direct relaxation of unstriped muscle fiber. It causes relaxation of the ureteric muscle in the region of the stone, and has been successful in causing stones to pass naturally.

3. With the operating cystoscope and the special scissors of Bransford Lewis it is possible to cut up the superior wall of the mouth of the ureter, starting from the mouth of the ureter and through the wall of the bladder for at least three-quarters of an inch. After this minor operation has been done it is possible to try and pull the stone down with forceps or to dilate the ureter with a probang through the cystoscope. So far Kidd has failed to catch a stone with forceps after this operation and pull it down, but in nine cases the stone has been passed naturally within a few days after he has cut the mouth of the ureter in this manner. In some cases he has been able to observe the slit some months afterwards. It appears to heal up soundly without stricture formation and causes no bad after-result. The lower end of the ureter is often very narrow in these cases and appears to be the main cause which prevents the stone from passing naturally. This method appears to be a triumph of manipulative surgery when we can thus get a stone to pass and save the patient from a major operation. Progress in surgery consists in substituting minor surgical procedures for major surgical operations. The treatment of villous growths of the bladder by fulguration through the cystoscope is another good instance. Surgeons are still very slow to adopt these methods and to give more spectacular and more dangerous procedures.

4. It is possible to cut the mouth of the ureter in similar fashion, using the insulated copper and platinum electrode through a cystoscope attached to a diathermy machine. In several cases this has been done successfully, but Kidd prefers the scissors method.

5. Finally, it has been suggested to pass a ureteric catheter, with a small dilatable bag attached, as far as the stone. The bag is dilated with air, and traction is made so as to dilate the ureter below the stone. The principle is similar to that of the bag used in midwifery for dilating the mouth of the uterus.

The methods briefly mentioned should be given a fair trial before an open operation is performed. Those, then, who wish to deal with these cases should make themselves familiar with the technique of operative cystoscopy.

The methods of operation are well-known; the author describes the types he has found most valuable.

Ureteral Transplantations. ROBERT V. DAY, Los Angeles. *The Urologic and Cutaneous Review,* August, 1920.

Objectively ureteral transplantation in general may be classified as follows:

1. For the purpose of sidetracking the urine for congenital defects, such as exstrophy (bowel implantation).

2. (a) Skin transplants in conditions where the patient has a reasonable expectancy of a few years of life if transplanted, as occasionally occurs in advanced tuberculous bladders that will not or have not healed after a long time, and the remaining kidney is but slightly infected and the function good; or in case of bilateral infection with the function in one fairly good, with the aforementioned highly contracted exquisitely irritable tuberculous bladder. Such cases by transplantation (where there are no tuberculous lesions elsewhere in the body) may be reasonably expectant of one, two, or even three years more of life comparatively free from pain and have far better health. (b) Or a skin transplant may offer a lengthening of life for a number of years in rare instances, where there exists trauma and infection on one side and there is doubt as to the future functional efficiency of the opposite kidney.

3. For purely palliative purposes

There are three types of cases in which this is applicable and preferable:

First, and most important: In cases of advanced and incurable tuberculous bladder with intractable vesical symptoms where both kidneys are tuberculous, or in case of a previous nephrectomy on one side, the other side has become so involved that an exquisitely irritable contracted viscus exists and suprapubic drainage would be of no avail, or having been instituted, has not sufficed, or has lost is usefulness by reason of further contraction of the bladder, making any kind of suprapubic drain intolerable.

Secondly, in carcinoma of the cervix, complicated by vesico-vaginal fistula and persistently excoriated skin that is maddening to the patient; or, in case of obstruction on one or both ureters, partial or complete, from carcinomatous infiltration primary in the cervix.

Thirdly, (a) in advanced cases of bladder carcinoma where suprapubic drainage would probably not be palliative, or having been instituted, has not relieved the tenesmus; or, (b) cases of nearly complete anuria from obstruction of the intramural portion of the ureters from carcinomatous infiltration at the base.

Bowel implantation is essentially an easy operation and given a normal ureter (without dilatation), with no kidney infection and a normal function, implantation into the gut offers a fair prognosis for a few years at least. However, with a dilated ureter and already infected kidney, ureter-to-gut anastomosis is practically a death sentence in from five to twelve days.

Transplantation into the bladder may be easy or most difficult—but almost never so easy as bowel insertion.

Ureteral transplants to the skin is an act of mercy in certain advanced cases of bladder carcinoma. It is all of that in some cases of bladder tuberculosis and, moreover, markedly prolongs life and lessens invalidism. It prolongs life in certain carcinomatous invasions from adjacent extra-urinary organs. Unlike any other anastomosis of the ureter, the kidney is not insulted in the slightest and drainage can be made perfect. Even bilateral anastomosis to the skin at one sitting is almost devoid of shock in the feeble. It is a most rapid and efficient method of treating pyelitis and restoring kidney function to the maximum in such cases as have been described.

Uretero-cutaneous transplant is one of the easiest operations of genito-urinary surgery.

With a soft catheter inserted just within the kidney pelvis, all insult to the kidney from edema of the orifice at the distal end of the transplanted ureter is prevented.

Nephrostomy is unsatisfactory and the kidney is pretty sure to get badly infected.

Transplantation of the ureters in the back, besides being inconvenient to care for, gives the transplanted ureter too abrupt a turn.

Where a kidney is to be saved in a patient with the opposite kidney functioning poorly, transplantation into the opposite ureter will probably lead to constriction, back pressure, and ultimately severe infection.

Abdominal Pain in Diseases of the Kidney and Ureter. ARTHUR B. CECIL, Los Angeles, *Journal of the American Medical Association,* November 6, 1920.

This study is based on a critical review of 300 cases in which a complete urologic investigation was carried out on the upper urinary tract. It was undertaken for the purpose of determining the frequency of occurrence and distribution of abdominal pain in association with diseases of the kidney and ureter. There were sixty-seven cases of stone in the kidney or ureter. Most of them occurred between the ages of 30 and 44. Blood was found in the urine in fifty-six cases, pus in fifty-four, albumin in thirty-two. Thirty cases showed bladder disturbances. Pain was present in every case, and in the large majority of cases the patients presented themselves for treatment on account of pain. In a few instances, hematuria was the principal complaint. Twenty-one cases presented typical renal pain. Nineteen cases presented pain in the abdomen alone. In twenty-six cases, pain in the back was associated with pain in the abdomen. The confusing nature of abdominal pain in cases of stone in the kidney and ureter is well brought out by the fact that in thirteen of the sixty-seven cases studied, various surgical procedures had been undertaken for the relief of pain in which the symptoms were in no way changed, and in which it has been demonstrated that the pain was of renal origin. In eight cases stone had not been diagnosed. A diagnosis of appendicitis had been made in five cases, gallstones in two cases, and ptomain poisoning in one case. The position of the stone, whether in the kidney or in the ureter, had little bearing on the distribution of the pain. In a group of forty cases of renal tuberculosis every case showed pus in the urine. Blood was found in the urine in thirty-eight cases, and albumin in thirty-four cases. Tubercle bacilli was found in every case directly by side investigation, and only in a few instances was a guinea-pig injection of any help. Abdominal pain was present, without pain in the back, in seven cases. In six cases, pain in the back was associated with pain in the abdomen. Pain in the back alone occurred in eight cases. In eighteen cases, no pain was complained of, and the symptoms were entirely limited to the bladder. No abdominal operations had been performed for relief of pain. Of seventy-seven cases of pyelonephritis pus was present in the urine in seventy-three cases; blood in forty-six; albumin in fifty. Of fifteen cases of left renal infection there was no pain in seven cases. In fifteen cases of right renal infection, pain was absent in five cases. In twenty-five of the forty-seven bilateral cases there was absence of either abdominal or renal pain. In only two instances were abdominal operations performed with the idea of relieving abdominal pain in this series of cases of pyelonephritis. Hydronephrosis and hydro-ureter comprised twenty-six cases. The urine showed pus in nineteen cases, blood in seventeen and albumin in fifteen. Bladder disturbances were present in thirteen cases. Pain, usually severe, was present in all these cases, either in the abdomen or in the back. Of two instances of tumor of both kidneys, one presented pain in the right upper abdomen, the other, colicky pain across the upper abdomen and left lower abdomen. Neither showed pain in the back. One case showed pain in the right back without any associated pain in the abdomen. One cases of hypernephroma presented pain in the renal region, but no abdominal pain. There was no abdominal pain or bladder disturbances in a case of polycystic kidney. Cecil advises that in obscure cases of abdominal pain, pyelographic studies should be

more frequently made. Urgency of operation in obscure abdominal pain does not often depend on severity of the pain alone. Some of the severest types of abdominal pain have as their origin diseases of the kidney and ureter.

Recent Progress in Kidney and Ureter Surgery. DANIEL N. EISENDRATH, Chicago. *Medical Record*, October 16, 1920.

Progress has been along three lines chiefly: (1) In diagnostic methods; (2) in operative technique and the application of non-operative methods of treatment, and (3) in the more accurate interpretation of certain familiar clinical symptoms such as ureteral colic, pyuria and hematuria.

1. *Improvements in Diagnostic Methods.*—These have been chiefly the result of the perfection of radiography as applied to the urinary tract, the chemistry of the blood as it interests the urologist and the bacteriologic study of renal infection.

(a) Pyelography and Ureterography. The pyleogram of a normal kidney shows in addition to the ampullary portion three major calyces, namely: superior, middle, and inferior, from each of which arise a number of minor calyces.

Variations from the normal pyelogram are not difficult to distinguish so that pyelography is of the greatest assistance in the diganosis of a number of surgical affections of the kidney. The increase in size of the shadow with widening of the narrow portions of the major calyces and a club-like dilatation of the minor calyces enables us to recognize the presence of an inflammatory or mechanical dilatation (hydronephrosis) of the renal pelvis.

In renal tuberculosis the eroded appearance of the calyces or the presence of widely scattered shadows is very characteristic.

Ureterography, the opaque catheter and the employment of stereoscopic *x*-ray exposures enable us to disminish the percentage of error in the differentiation of true (intraureteral) from false (extraureteral) shadows.

(b) Radiography alone without the aid of the opaque catheter, stereoscopy, pyelography, and ureterography enables us to tell with a fair degree of accuracy the exact location of calculi in the kidney, i.e., whether in the pelvis proper, in one of the calyces, or in the parenchyma. In cases giving the typical history of calculus in the upper urinary tract it is often possible to intensify a weak or doubtful shadow by the application of the principles underlying pyelography and ureterography, i.e., taking a second picture after impregnating the calculus (through the ureteral catheter) with a solution giving an *x*-ray shadow.

The differentiation of true intrarenal from false extrarenal shadows, such as calcified glands, gallstones, etc., has been rendered far easier through the introduction of the opaque catheter and the use of pyelography.

In renal tuberculosis, radiography alone is of great service in diagnosis when it is impossible or undesirable to catheterize the ureters. The recent observations of Braasch, Colston and Waters have shown that one can readily recognize the more advanced cases of renal tuberculosis by the appearance of the kidney on the *x*-ray plate.

2. *Improvements in Operative Technique and in the Application of Non-operative Methods.*—Of chief interest are (a) the study of the anomalies of the renal vessels and (b) the almost general substitution of the operation known as pyelotomy for that of nephrotomy.

The presence of accessory arteries and veins passing directly from the aorta, vena cava, or iliac vessels to the upper or lower poles of the kidneys compels the operator to expose these poles carefully in order to avoid serious bleeding during or after operation on the kidney.

Nephrotomy for the removal of calculi is followed in a fairly large percentage of cases by secondary hemorrhage, hence it is being used less frequently from year to year. The route of election is through an incision in the posterior surface of the renal pelvis where the danger of bleeding is reduced to a minimum.

The treatment of infections of the kidney involving chiefly the pelvis has been greatly simplified as the result of the direct applications of antiseptics to the renal pelvis when injected through the ureteral catheter. Pelvic lavage enables us to cure many a severe case of pyelitis which formerly proved resistant to ordinary treatment. In the study of the bacteriology of the upper urinary tract smears made from sediment obtained after the use of the high power centrifuge have almost completely supplanted cultures or animal inoculation.

The non-operative delivery of ureteral calculi is a method which should be given a fair trial before operation is decided upon.

Occluded Renal Tuberculosis. W. F. BRAASCH, Rochester, Minn. *Journal of the American Medical Association*, November 13, 1920.

Braasch states that renal occlusion occurs in about 10 per cent. of the cases of chronic renal tuberculosis. It can be recognized by means of clinical, roentgenographic and cystoscopic data in fully 90 per cent. The usual symptoms are persistent frequency, dull pain or abdominal tumor; they usually extend over a period of many years. The occluded kidney may be a focus of infection, if the occlusion is of recent occurrence. If it has existed for many years it usually becomes sterile. In the presence of persistent frequency, dull pain or abdominal tumor, nephrectomy is indicated. The post-operative results are usually excellent, with recovery from the various symptoms. In case of bilateral tuberculosis, the removal of an occluded kidney will not benefit the patient and operation should not be performed.

Papillomatous Epithelioma of the Kidney Pelvis. P. E. MCCOWN, Indianapolis. *Journal of the American Medical Association*, October 30, 1920.

Forty-eight papillary tumors of the kidney pelvis are analyzed on the basis of cases reported in American and foreign literature. In listing the symptoms, hematuria was reported in twenty-three cases and hematuria with renal colic in twelve cases, palpable tumor fourteen times and abdominal pain in eight instances, while in six cases there was reported frequency or painful urination. As illustrating the possible malignancy of this condition, eleven authors report metastasis as being present at the time of examinations or developing in the later course of the disease. It would seem, however, that all cases are potentially malignant since this is the outcome of untreated papillomas of the bladder. Roentgenoscopy has not proved much aid in the diagnosis of these conditions. Nephrectomy is the treatment indicated, and since the ureter and bladder show a strong tendency to become involved, it would seem best to perform complete ureterectomy at the time the kidney is removed or soon after. Secondary growths on the bladder mucosa can be easily destroyed by fulguration unless they have become malignant. A study of these cases shows that malignancy is not an early development, giving all the more hope for complete cure by nephroureterectomy.

Progress in Nephrectomy. A Study Based on a Series of Two Hundred and Seven Cases EDWIN BEER and ABRAHAM HYMAN. New York; *Journal of the American Medical Association*, October 30, 1920.

This article by Edwin Beer and Abraham Hyman is based on a series of 207 nephrectomies with a mortality of 3.8 per cent. Of the 207 nephrectomies, 189 were primary, 18 secondary; 199 were lumbar extirpations, 8 transperitoneal. Subcapsular nephectomy was performed twelve times. Two of the eight deaths occurred after secondary nephrectomy. The majority of patients were operated on under gas and ether; gas-oxygen was used in fifteen cases, and spinal anesthesia in two. The unquestionable value of cystoscopic and functional examinations in lowering the mortality is emphasized especially in the reduction of the death rate from uremia. Full details are given.

Book Reviews

Manuel D'Urétroscopie. By ROBERT HENRY and ANDRÉ DEMONCHY. Octavo; 113 pages; 56 illustrations and 5 color plates. PARIS: MASSON ET CIE, 1920.

This little work is valuable, if for no other reason, in that it emphasises the necessity for the use of the urethroscope in the diagnosis and treatment of chronic urethral conditions.

The first chapter is devoted to the discussion of the indications for urethroscopy, and very properly cautions against its use in the acute stage of gonorrheal and other inflammations of the urethra. But the authors, with equal propriety, urge its systematic application in the subacute and chronic stages when all acute inflammatory symptoms have subsided and the gonococcus has disappeared from the discharge.

The second and third chapters treat of the history of the instrument, the various modern types, and the technique necessary in the use of each of them. The text is carefully descriptive, but the illustration of Luy's urethroscope on page 19 (fig. 9) and again that of Demonchy's on page 47 (fig. 24), have the end cut away to show the position of the lamp, without any explanation on the cut. This might tend to confuse one not familiar with the instrument; as it gives the idea that the distal end is cut on a bevel, which of course is not the case.

Chapter four is devoted to a critical discussion of the value and merits of the various instruments described, and concludes with a strong argument for the lamp placed at the distal end.

Chapter five gives a careful and circumstantial description of the appearance of the normal urethra; with two colored plates of six figures each.

Chapter six deals with the pathological appearances of the urethra and is illustrated by three colored plates of six figures each.

Chapter seven gives the technique of the various internal maneuvers necessary in treatment, and illustration of the various auxiliary instruments used.

This work makes no pretention to being an exhaustive treatise of the subject, but it should be of great use to those who have to employ the instrument only occasionally; while those who are more experienced will be well repaid for the short time it will take to read it through.

American Medical Biographies. By HOWARD A. KELLY, M.D., L.L.D., F.A.C.S., HON. F.R.C.S. (Edin.) and WALTER L. BURRAGE, A.M., M.D. Large octavo; 1284 pages. Baltimore: THE NORMAN, REMINGTON COMPANY, 1920.

Prof. Howard Kelly has made many contributions to medical history and biography. Much the largest and most important of these was the two-volume "Cyclopedia of American Medical Biography" which he edited and published in 1912 (W. B. Saunders Co.). This work comprised the biographic sketches (1184 in number) of "every medical worthy" in the United States and Canada from 1610 to 1910. It also contained interesting accounts of the birth and growth of various spheres and specialties of medicine in America. This cyclopedia was far more complete than any American medical biography published before or—except the present volume by the same editor—since. Garrison's classic "History of Medicine" had not then appeared.

The present work, "American Medical Biographies," is a successor to, a revised edition of, the "Cyclopedia." Dr. Kelly and Dr. Burrage "have worked for several years to produce the present volume, deleting from the former book 51 biographies not coming up to our standard, replacing with new biographies 62 others, revising and correcting from original sources nearly all, and adding 815 new ones, besides those that have replaced the old ones. Thus our book contains 1948 biographies and is carried through the year 1918. In addition there are about 80 references to individuals mentioned biographically in the main biographies."

This work is, therefore, much larger than its predecessor, the Cyclopedia. Nevertheless, it was made possible to reduce it from two volumes to one, by employing less bulky paper and a somewhat larger page. The few portraits in the Cyclopedia have also been omitted, and so has the historical section. Presumably the editors believed that the latter had been made unnecessary by Garrison's remarkable History, which this work is, indeed, intended to supplement.

Omitted, too, is the list of contributors. They are very many, and, as before, each biography bears the author's name. A new feature is an index to the biographies (which, since the arrangement is alphabetical, is useful chiefly for the reference to those "worthies" who are referred to only incidentally in the sketches), and a "regional index," which will be helpful indeed for local medical historians.

A glance at the long list of "works chiefly consulted" in preparing these biographies will afford some measure of appreciation of the work performed by the editors, their collaborators and contributors. To all of them the medical profession of the United States and Canada has cause to be grateful.

The Oxford Medicine. By Various Authors. Edited by HENRY A. CHRISTIAN, A. M., M. D., Hersey Professor of the Theory and Practice of Physic, Harvard University; Physician-in-Chief to the Peter Bent Brigham Hospital, Boston, Mass., and SIR JAMES MACKENZIE, M. D., F. R. C. P., LL. D., F. R. S., Consulting Physician to the London Hospital, and Director of the Clinical Institute, St. Andrews, Scotland. *Volume* 1. *The Fundamental Sciences and General Topics.* Large octavo; 921 pages; illustrated. London and New York: OXFORD UNIVERSITY PRESS, 1920.

This handsomely published "System of Medicine," the third, in English, to appear within the past two years, enters the field under unusual auspices. Its international character, the high standing of the editors, the caliber of the writers assigned to their chosen topics as set forth in the prospectus, the foremat of the work, so issued ("loose leaf") as to permit extension or revision of the contents—all create high anticipations.

The first volume fulfils in a large measure our expectations. The authors of the assigned topics have been well chosen and with one or two exceptions their articles are well written, some superlatively so. It is impossible within a limited review to submit a critique of the twenty-five chapters comprised within this volume. It is a pleasure, however, to express our special commendation of the following articles: Gay on "The Mechanism of Bodily Resistance to Disease"; Van Slyke, "The Chemistry of the Proteins and Their Relations to Disease"; Henderson on "Acidosis"; Sewall on "Climate"; and Rountree on "The Pharmacological Basis of Medicine." The jewel in this book is the essay on "The Treatment of Disease" by Osler. This reveals all the charm of style, literary skill, scholarliness and the human touch for which the writings of this lamented master are so widely loved.

The remaining articles vary in quality. Some are too superficial and didactic to be of much value. A surprising disappointment is the chapter on "Focal Infection" by Billings. The attempt seems to have been to "make a case" for the theory of focal infection; it is written almost entirely from the standpoint of the advocate rather than that of the critic. In consequence the chapter contains many statements that will bear challenge; for instance (p. 167), "the most unusual focus of infection that is the source of streptococcus bacteremia is pyorrhea alveolaris."

The discussion of special diseases is promised for the succeeding volumes. We await their publication with keen interest.

American Journal of Surgery

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[American Journal of Anesthesia and Analgesia]

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January — 1920

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THE ADMINISTRATION OF ANESTHETIC IN HOME MILITARY HOSPITALS.*

J. F. W. SILK, M.D., Lt.-Col. R.A.M.C.
LONDON, ENGLAND.

From the beginning of August, 1915, to the end of July, 1916, I occupied the position of Consulting Anesthetist to the Malta Command, that is, during the period of the Gallipoli activities, when the greater part of the beds that the island contained were occupied by surgical cases. For the last fourteen months I have been in a similar position at home, and in that capacity I have visited all, or nearly all, the principal military surgical hospitals in England. In Malta, of course, all the *deaths under anesthetics* were notified to me, and since the middle of January of this year I have received detailed reports of all the fatalities in England, Scotland, and Ireland.

Most of you will recollect, I expect, that in the pre-war days I always deprecated the endeavor to use any one anesthetic, or any one method in every case, and insisted upon the advantages of varying one's procedure in accordance with certain elemental circumstances such as sex, age, physical condition, and nature of the operation. While my views upon this point remain unchanged, I appreciate the fact that the relative values of these respective factors have altered materially under the stress of war. Questions of age and sex have practically disappeared, and the main determining factors are those of the previous condition and the nature of the operation, and even these have very much altered.

DETERMINING FACTS.

First of all with regard to the factor of the previous condition, it seems to me that except for the secondary results of his injury, the soldier may be described as an average healthy male. But these secondary results are of much importance, and introduce, factors which are comparatively speaking unknown in civilian practice. For instance, with the acute shock of the battle-field we have but little to do in the home hospitals, but, on the other hand, very many of the men are suffering from a condition of *chronic shock* which renders them rather troublesome from the anesthetist's point of view. Then again, many of the soldiers have been the subject of a somewhat prolonged suppuration of varying intensity. This may not perhaps produce all or any of the characteristic objective symptoms of acute sepsis, but I am sure that it has a very bad effect upon the heart muscle. It is rather more than a mere coincidence that of forty post-mortems at home the heart muscle was found more or less degenerate in twenty-six, and of these twenty-six there were definite records of prolongd sepsis in twenty. A somewhat similar degeneration, too, results from malarial poisoning, to which the troops are exposed upon some of the fronts. *In Malta the question of the effects of malaria upon the heart muscle and its relation to death under anesthetic was the subject of an exhaustive inquiry by the authorities in that island.*

We do not, nowadays, hear very much about the so-called *soldier's heart,* which was the subject of so much controversy about the time of the Crimean War and after. I am myself inclined to believe, however, that *the dilated heart of over-training and under-feeding is of fairly frequent occurrence, and when by a rare chance such a patient comes under the anesthetic, trouble is very likely to arise.*

As regards the nature of the operation, the differences entailed by war conditions are so obvious that one need do no more than enumerate them. Intracranial injuries are usually treated at the base hospitals abroad, and we see but few at home. At any rate, I know that while I was in Malta such operations were of almost daily occurrence, but I do not think that I have seen a single one since I have been doing home work. Injuries involving the pleuræ are relatively numerous, severe, and complicated. Abdominal surgery, except in point of view of numbers, does not seem to me to differ from similar cases in civil life. *There are, however, at least three classes of case in which the work of the anesthetist has been most distinctly altered and severely tried. I allude to spinal injuries, orthopedic surgery in general, and plastic operations upon the face.*

Looking at the whole subject from a broad general point of view, I should be inclined to say that in military surgery the exceptional cases call more insistently for variations in methods of anesthetization than in civil life. But, on the other hand, the number of normal or straight-forward cases is relatively larger. This means of course that our first consideration is the selection of an anesthetic and method which may be employed almost as a matter of routine.

SELECTION OF ANESTHETIC AND ROUTINE METHODS OF ADMINISTRATION.

In deciding this question there are two very important points which must not be lost sight of. The first is the personality of the anesthetist. The additional military and war hospitals scattered throughout the country are to be numbered by hun-

* Read before the Royal Society of Medicine, Section of Anesthetics.

dreds, and the difficulty of supplying them with skilled or even efficient anesthetists is very great. The patriotism and willingness with which medical men and women have come forward to staff these hospitals are quite above any praises of mine, but I am sure that none of them will mind my saying that the task of administering anesthetic has not always been one with which they have been most pleased or for which they have considered themselves the best fitted.

The second point is that the large number of military hospitals taken in conjunction with the frequent and necessary changes in the anesthetists who work them, renders it very desirable to standardize the equipment provided, and to render that equipment as simple as is compatible with efficiency. The standard at present is:

(1) Nitrous oxid apparatus.
(2) Schimmelbusch's frame.
(3) Clover's inhaler.
(4) Junker's bottle (Rigby's safety pattern is now issued).
(5) Tongue forceps.
(6) Mouth gag.

One or more of each is provided in accordance with the size of the hospital and the number of operating theatres in use. For special hospitals, and where special cases are treated by special anesthetists, special instruments are obtainable. To my mind the War Office is quite generous in this respect, but naturally the authorities do not wish to lend themselves to the exploitation of cranks and instrument makers.

On the whole, therefore, one is bound to select as a routine anesthetic a method which is the least liable to abuse, and in the use of which the anesthetist, even if rather below the average, is least likely to go wrong. Amid conflicting opinions the task is not so easy as it seems. There is one negative point, however, upon which I hope my opinion may be largely supported—*i. e.*, that in military surgery at home the routine use of pure, unadulterated, or as our American colleagues call it, *straight chloroform*, as a first choice is to be avoided as much as possible. Briefly stated, my chief reasons are the following:

(1) In the hands of the most skilled the mortality is relatively high. I believe that it is something approaching 1 in 2,000. In military work I do not know exactly what the proportion may be, but I will give you some figure: *Of the deaths under anesthetics which have been reported to me since January, 1917, at least 55 per cent., and probably more, were due to or occurred under chloroform used in an undiluted form, and in many other cases the chloroform was by far the predominating drug. One may admit, of course, that in many of these cases the use of chloroform was almost imperative, and that in many the condition of the patient was such, that in all probability he would have died under any other anesthetic, but such admissions do not really affect the figures. I would further point out that of that 55 per cent., in fully 28 per cent. death occurred before any operation had commenced.*

(2) In the course of my wanderings, I have been much struck by the fact that of the most earnest advocates of pure chloroform, only a comparatively small number really know how to give the drug properly. As an example of this, let me instance the gentleman whom I found pouring drachm doses of chloroform upon a lint-covered Schimmelbusch's mask, over which, and his retaining hand, he had thrown another sheet of lint about the size of a pocket handkerchief. From the same hospital I received complaint of the impurity of the chloroform which, I was told gave rise to a great deal of lividity.

Although I object to the use of undiluted chloroform as a first choice, for routine work, it must not be supposed that my condemnation extends further than this. I fully recognize the value of this drug for many cases, and I would even say that when sufficiently diluted down with ether in the shape of one or other of the mixtures, and administered carefully by the open method it forms a very simple and admirable method of inducing anesthesia previous to the continuous use of ether.

For quite short cases some form of local anesthetic is, I believe, often employed, but these naturally do not come under my ken, and I have no means of knowing exactly to what extent this method is really employed. I am inclined to think, however, that it is not employed nearly to the extent that its most earnest advocates could wish, and for this I have no doubt that the surgeons could give sufficient reason.

For similar short cases an alternative is nitrous oxid. This is not used nearly so often as I should like to see it used. Two difficulties arise with regard to it. First of all the supply is somewhat scanty and irregular, and in the second place the average anesthetist in the military hospitals rather fights shy of it.

OPEN ETHERIZATION.

Failing local drugs and nitrous oxid, the anesthetic of my choice for continuous work is ether, and with certain reservations and precautions I prefer

the open method. The details of the particular method that I advocate do not, I expect, differ very materially from those employed by most of you, but in order to make myself quite clear, I will briefly refer to the points upon which I like to insist:

(1) A preliminary injection of morphin ¼ gr. and atrophin 1/100 gr. For military work I think that this should be given rather less than half an hour before the operation. In my opinion the orthodox one hour is too long. See, too, that the *patient* gets the full dose, not the bedclothes.

(2) A small pad of Gamgee tissue with a hole in it round the nose and mouth.

(3) A Schimmelbusch's mask covered with from twelve to twenty layers of gauze. This may be clipped to the pad by means of tongue forceps, and a useful hinge is thus formed.

(4) Although when time is no object and the surgeon is good natured, one can start with ether from the very beginning, I think that it is better in most cases partly to induce with a mixture, or even with a Clover's inhaler. In many cases I employ chlorid of ethyl on the open mask in the manner suggested by Dr. Barton.

(5) As a drop-bottle I recommend the metal flask devised by my friend, Dr. McCardie, of Birmingham. This enables one partially to regulate the flow of ether, and is therefore economical; it also possesses the great advantage of being practically unbreakable.

(6) The late Sir Frederic Hewitt introduced a very useful open airway tube passed into the mouth over the base of the tongue. I prefer to pass a smaller and softer tube about 5 in. down the nose, a device which I have found most useful, and now employ in almost every case.

This is the plan that I have advocated at most of the military hospitals which I have visited, and I believe that it is very widely adopted. The equipment of all military and war hospitals includes one or more Clover's inhalers, and at some of the hospitals I have visited I find that the anesthetist is rather wedded to that instrument and will not succumb to my blandishments in favor of the open method. Under these circumstances I generally suggest to him to try the plan proposed by Dr. McCardie of putting 1 dr. of chloroform into each 2 oz. charge of ether. I have myself had much success with this method, and believe it to be capable of extension in various directions, for instance, I am inclined to think that the same degree of dilution might be used by the open method all through, and would to some extent meet the objection so often raised as to the large quantity of ether required in long cases. In this connection I may perhaps say that from a large number of figures I have obtained I estimate that the quantity of ether required for open administration works out at 6 to 8 oz. per hour (in Malta it was to 8 to 10 oz.). Whichever plan has been adopted, I am very certain that less pure chloroform and more ether is being given in the home hospitals now than was the case twelve months ago. I think, too, that I can point to some definitely good results which have followed the change, for the death-rate for the quarter ending September 30 has been rather less than one-half of the average rate for the two quarters preceding.

ANESTHESIA FOR SPECIAL CASES.

I now come to the question of the anesthetic to be used in the various special cases to which I have alluded. *In the cases of modified or chronic shock to which I have referred I doubt whether one can give too much morphia, but in cases of sepsis, malaria and other heart trouble, I would avoid the use of morphia.* In other respects I would base my anesthetic treatment of all these cases upon three fundamental lines, viz.:

(1) Avoid all but the most dilute doses of chloroform.

(2) Give as little anesthetic of any sort as possible.

(3) Avoid anything like asphyxia, by diluting the vapor very freely. For which purpose oxygen given either by itself or bubbled through your anesthetizing agent is very useful.

It is in such cases as these that the use of the continuous gas and oxygen methods of the American surgeons seems likely to be of considerable value. Others who are here to-night will probably speak to you more in detail as to the particular advantages of this method. All I will say at present about it is that the present forms of apparatus seem to me to militate considerably against its general employment, nor am I quite convinced as to the quality of the anesthesia produced.

In discussing the question of a routine anesthetic I purposely avoided any allusion to the warm ether method, mainly because Dr. Shipway will probably speak upon that method, but partly because it does not appear to be used to any great extent at home, partly, also, because the method seems to me to lack that element of simplicity which I believe to be so essential when dealing with a large number of administrators of varying skill and capacity. I think, however, that in the class of cases with which I am now dealing—*i. e.*, chronic shock and sepsis, warm ether would very likely be of considerable advantage. *In intracranial cases, morphin*

is usually unnecessary, as the patient is often in a semi-comatose or dazed condition. For the same reason, too, very little anesthetic is required. In these cases I prefer chloroform because it is desirable to limit the venous congestion as much as possible. I usually administer it by means of a Junker's bottle, through which I pass a very small stream of oxygen, leading the mixture of chloroform vapor and oxygen down the nose by means of a soft tube.

The mortality arising from operations of the empyema type is rather heavy. Most of the cases dealt with in the home hospitals are of course of the chronic type, and have been the subject of prolonged and severe suppuration. They are, therefore, particularly bad subjects for anesthetics of any sort. There is no doubt that these cases ought all to have some form of artificial respiration as is typified in the intratracheal method. Unfortunately, however, my experience is that neither the anesthetist nor the surgeon seem always to grasp the seriousness of the problem which is before them when they decide to operate. The intratracheal apparatus is so cumbersome, costly, and difficult to manipulate that but very few establishments are equipped with it. Not only so, but the anesthetists are constantly changing, so that even when one man has learned to use it the probabilities are that he gives place to another in the course of a few weeks who does not know how to use the machine. I can only think that these cases ought to be concentrated in a few of the better equipped hospitals where this method is available. Failing this, chloroform and oxygen should be given very gently from a Junker throughout the operation.

In cases of spinal injury the position is often complicated by the fact that the patient is turned wholly or partly upon his face; this not only entails compression of the chest but obliges one to pump the anesthetic into him. Then again, avoidance of venous congestion is desirable. Taking all these points into consideration I am inclined to give these patients oxygen and mixture from a Junker's bottle. But these are cases in which the care and vigilance of the anesthetist are more important than the actual method employed.

One would imagine that orthopedic surgery was the special field for the use of the intraspinal methods, but I am surprised to find that, as far as my experience goes, this is not the case; nor is any explanation forthcoming. Nitrous oxid is frequently used, and it requires a good deal of skill in the manipulation of the administration to hit off the precise moment at which the fullest possible degree of relaxation is obtainable. The average orthopedic case does well enough with ether, but it must be ether given without a trace of asphyxia so that there is as little congestion of the veins as possible. At one of the orthopedic hospitals visited I received complaints about the amount of venous congestion, which in this instance was attributed to the use of warm ether, and unless the warmth of the ether vapor is very carefully regulated it does seem to produce considerable venous congestion.

ANESTHETIC FOR PLASTIC FACE SURGERY.

The question of the anesthetic in plastic face surgery and allied conditions deserves a whole evening to itself. It is one in which I have taken a great deal of personal interest, and one of the most difficult questions with which we have to deal. *The chief troubles arise partly from the presence of large quantities of blood in the mouth and pharynx, partly from the necessity of getting out of the way of the operator, and partly also from the difficulty in manipulating the anesthetic when the jaw is wholly or partly fixed, or even perhaps unduly mobile. There is no operation in which the anesthetist can be of so much real assistance to the surgeon, or where the value of a good anesthetic is so conspicuous.* For this reason I do not favor the view sometimes taken that one particular method should alone be employed. Not only do the cases vary very much in themselves, but one should take into account the capabilities of the anesthetist. In some few instances the ordinary routine methods are possible, but these are rather in the minority. In most cases exceptional methods will have to be employed. Of these exceptional methods I recognize four varieties.

(1) *The intratracheal method.* I place this first on the list, for just now it is very much in fashion. I acknowledge that in some cases it is almost indispensable, but I do *not* admit that it is necessary or even advisable in all or even in the majority of cases. Time, however, will not permit me to give my reasons for this opinion.

(2) Allied to this plan is what I would call *the intubation method,* by the means of a Kühn's tube. This method is little known in this country and I believe that it has many advantages, for the whole of the pharynx can be fully packed and the blood and mucus are then absorbed.

(3) Another plan which I also think is not as much practiced as it should be, is the *colonic ether-oil method* of Gwathmey. I have used it myself many times and seen it used by others, and always with satisfaction and advantage. It is probably

the simpliest known method of giving an anesthetic.

(4) The fourth plan—*the method of position*—is one I naturally esteem highly, as I am mainly responsible for its use in this type of case; but for that very reason I am not disposed to say much about it now. Anesthesia is induced with the patient sitting bolt upright on the table, any routine plan being adopted. The anesthesia is maintained by means of a nose-tube conveying oxygen and chloroform vapor; or the vapor of mixture or ether may be used. This plan has been sharply criticized, but at least I can say of it that it has been in use now for over a year at one of the principal "facial" hospitals in the kingdom, and that no fatalities have attended its use.

Whichever plan be employed, it may be supplemented by the use of some form of suction apparatus on the principle of similar tubes used by dental surgeons and with the same object—viz., the removal of blood and mucus from the buccal cavity.

ETHER BRONCHITIS RECORDS.

Before concluding what I have to say on the methods of anesthetization there are, however, two minor points to which I should like to draw your attention. The first of these is the occurrence of the so-called *ether bronchitis*. In the pre-war days one was very much inclined to put this down offhand to simple exposure, either in draughty passages or in the wards themselves. In my visits to hospitals of very varied type throughout the country, however, I have come across cases of bronchitis under such different conditions and surroundings that I am not at all sure that the theory of *exposure* will hold good. In some places it almost appears to be epidemic: in others it partakes of the nature of an epidemic; while in other places again where it ought to be rampant it hardly ever occurs. The second point is the question of records. In the original army scheme the only provision made for recording the work of the anesthetist was in the shape of one, or at most two rather narrow columns in the *operation book*. In Malta I drew up a form for this purpose, and from it I obtained some valuable information, the hospitals being all within reach and the operations not over numerous. A somewhat similar form is now in use too, in most of the English Commands. But I am not satisfied with the results; the figures do not appear so reliable. But at any rate I think that they have served one useful purpose—viz., that of increasing the interest of the men in their anesthetic work, something that is very desirable.

TRAUMATIC SHOCK AND ITS TREATMENT.*

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INTRODUCTION: Most surgeons are called upon at one time or another to treat cases of traumatic shock. As a rule, they are accidental cases occurring in the factory, street or railroad crossing. One finds all stages of shock in such cases and not infrequently, the surgeon has to act quickly to save the life of the patient.

As one would expect, traumatic shock was a frequent occurrence on the battlefield and although, both American and foreign workers have given considerable study to this problem, the results obtained were nevertheless of little value from a practical viewpoint. This, as will be shown in the text, was largely due to the fact that most of these investigators adhered to the theory of the nervous origin of shock, instead of the theory of the toxic origin of shock, long advocated by the author.

We also frequently witness manifestations of shock on the operating table, shown by patients during anesthesia. This is particularly true in operations of the stomach as well as general abdominal surgery. It is evident, therefore, that it is of the utmost importance to the surgeon to have a precise knowledge of the phenomenon of shock.

The anesthetist also needs to fully understand the nature of shock. In the first place, shock may be produced by anesthetics such as chloroform and ether. Secondly, shock may be developed after recovery from anesthesia. Finally, traumatic shock is regarded as a contra-indication for anesthesia. It is thus evident to what extent it is important not only for the surgeon but for the anesthetist as well, to fully understand the nature, etiology and pathology of shock and also the rational method for preventing and combating shock.

REVIEW OF LITERATURE.

There still exists much difference of opinion with regards to the nature of shock. Goltz, who, it will be recalled, produced shock by tapping the surface of the body of animals, regarded it as a vaso-motor reflex phenomenon. In our country after the Civil War three military surgeons, Weir Mitchell, Moorehouse and Keene, supported the Goltz theory of the nerve origin of shock. More recently physiologists working along this field, have also supported this view. Crile and Meltzer, while making a slight difference in their explanations, are practi-

*Read during the Seventh Annual Meeting of the American Association of Anesthetists, at Atlantic City, June 9-10, 1919.

cally committed to the nerve origin of shock. Cannon (Jour. A. M. A., Vol. 70, P. 617, 1918) states that "Primary wound shock may come on so soon after injury as to be accounted for only as a result of nervous action, and as pointed out in the earlier paper. the individual with acidosis (is) sensitized so that operation, because still further increasing the acidosis and still further lowering the blood pressure, becomes hazardous. It leaves unsettled .... the occasion for the primary fall of pressure though the suggestion is offered that it may be of reflex character."

The nerve origin of shock has been accepted practically in toto by the Allied Medical Research Committee in England and The National Research Committee of the different universities of this country. The mode of treatment they recommend in wound injury and trauma, consisted largely of antiseptics and drainage. But the failure of this treatment is now generally conceded. Crowell finds no evidence of any permanent benefit following the injection of drugs in such cases. Armstrong expresses his belief that the value of antiseptics and drainage in trauma is entirely overestimated and Bainbridge reports in the U. S. Naval Bulletin (1918) that the use of antiseptics was definitely abandoned in favor of operative surgery.

THE WRITER'S THEORY OF SHOCK.

Some years ago while investigating cell necrosis I was led to the view that traumatic shock was caused by poisons or toxins liberated from the wound itself and my experimental and clinical studies in this field since that time, have furnished abundant evidence of the correctness of this view.

Briefly stated, in trauma we have destruction of tissue. This tissue is immediately attacked by enzymes, which cause it to undergo autolysis. During this autolysis split proteins are set free which are extremely toxic and when liberated in large enough quantities, cause traumatic shock. It is evident from this view that one of the primary considerations in the treatment of traumatic shock ought to be the removal of the devitilized tissue from the wound and thus prevent the poisonous split proteins from spreading destruction to normal tissue. This explains why surgery in traumatic shock is more successful than antiseptics and drainage. In the latter you have a slow process of killing the bacteria and removing the pus. If the antiseptic is too strong it only helps to bring about further cell necrosis. In surgery, however, the removal of the larger quantity of necrosed cells is brought about which minimizes the production of toxic split proteins.

Brachet brings out this point very forcibly adding "that while interventionists may sometimes have to regret the hypothetical preservation of a limb or one of its segments, conservatives often have to regret the loss of life." This is precisely what Du Bouys, one of the surgeons of the Revolutionary War, states, saying that "American Surgeons amputated at once and lost but few, but the French delayed and lost many." Larry, who was the first Naval Surgeon who cruised in American Waters (1787) and who afterwards became Surgeon in Chief of the first Napoleonic Army says, "I have lost a great number of soldiers, because although operated upon within the first twenty-four hours, yet the operation has been performed too late. It is then demonstrated that the "commotion" (shock) far from being a contra-indication to primitive amputation, ought to decide the surgeon in its favor. The effects of "commotion" (shock) far from being aggravated, diminishes and disappears after the operation."

Going back to the nature of shock, any agent capable of destroying tissue, may be an etiological factor of shock. Chloroform and ether cause cell necrosis and, therefore, produce shock or increase it when already present. My investigations amply explain why debridement not only removes the devitalized tissue from the wound, but prevents the poison of dead tissue from spreading cell destruction to the normal tissue. Primary suture restores the circulation of the injured part and puts a stop to further cell necrosis. This operative procedure promptly reduces the amount of cellular poison that is generated following the injury of tissue cells occurring in every wound. Crile (Canadian Med. Assn. Journal, Nov., 1918) mentions the biological importance of the effect of debridement and primary suture. He states "When the wound was surgically completed it contained many bacteria, but the obstacles to its biological defense had been removed. Then followed in natural sequence the usual "asceptic fever" and rise in blood pressure which is a good sign in recovery from shock." This clearly indicates that the presence of bacteria in a wound does not necessarily interfere with recovery from shock. Crandon and Ehrenfield are in entire agreement with my views, stating, "This reaction from shock is due to the absorption of decomposed products set free by disintegration of tissue." When these decomposed products of tissue disintegration become excessive and allowed to continue, death rapidly follows.

Although I consider surgery far superior than antiseptics in the treatment of traumatic shock. I

am not advocating the employment of surgery in all cases. Indeed, most of the cases of traumatic shock which I had occasion to treat, were restored without recourse to surgery. My treatment is both physical and biological rather than surgical, as is explained later. Before, however, taking up the subject of treatment, it will be well to discuss my experimental data on the nature of shock.

EXPERIMENTAL.

The traumatic shock syndrome follows whenever destruction of tissue takes place. In the laboratory shock may be produced by simple ligature, cutting off the blood supply of a part. The interruption of the circulation prevents the tissues below the ligature from being nourished. Cell necrosis promptly follows. The changes taking place in the cell and tissue under these conditions have been well described by Virchow. It is in this cellular disintegration with the formation of modified albumin in the tissue (Virchow) that we are most concerned in traumatic shock.

The following is a typical experiment which shows the relation between cellular disintegration products and traumatic shock. A ligature (Esmarch) was placed around the thigh of a dog and immediately a small portion of tissue was cut off from a point below the ligature. This tissue was at once frozen, cut and stained. On examination, cytoplasm and nuclei were found to be normal. A small portion of this fresh tissue was then rubbed up with salt solution and injected subcutaneously in the animal. No injurious effects were observed. The injured limb was allowed to remain for three hours quiescent with a view of bringing about cell necrosis with alterations in the tissue albumins. Again a frozen section was obtained from a point below the ligature. On examination of cytoplasm and nuclei, it was evident that necrotic changes have taken place. The stain was indistinct and vacuoles were present. An emulsion in saline was then prepared from this disintegrated tissue and small quantity of this emulsion injected subcutaneously into another dog. The syndrome of shock followed with fall in blood pressure, fall in temperature and death. Autopsy was immediately performed and the *most marked feature observed in this animal was splanchnic stasis.*

Furthermore, section of the liver, lung and upper alimentary tract showed that the blood had stopped in the pulmonary zone of lung, portal zone of liver and submucosa of upper alimentary tract. In other words, it was a complete blood stasis in the splanchnic area which is the true primary pathogenesis of shock as described by the writer in 1897.

Finally, after removing the ligature, the animal's leg was gently massaged with this view in mind, that the disintegrated or modified albumins of the necrosed tissue of the leg, be carried into the general circulation. Immediately there was a drop in temperature and blood pressure with shallow respiration; in fact all the syndromes of traumatic shock, the animal dying within a short while after this procedure.

THE RELATION OF TISSUE DISINTEGRATION TO TRAUMATIC SHOCK:

Animal	Character of Site of injury	Release of Ligature Hours after injury	Appearance of Shock Sym. Hours after release of ligature	Death Hours after Release of ligature	Time of Exam. After Sym. of Shock.
1. Cat	Mangled upper part of thigh.	2	2½	5	
2. Cat	Crushed lower part of thigh.	2	2¼	6	
3. Cat	Subcutaneous, clamp-thigh	1½	3	8	
4. Dog	Both thighs; constriction over ileac vessels	2	2½	7	
5. Cat	Crushing thigh	1	2		6 hrs.
6. Dog	Mangled upper thigh	2	3		7 hrs.
7. Dog	Crushing thigh clamps	1	2	9	
8. Rabbit	Mangled thigh	2	2½	6	
9. Rabbit	Extensive wound upper and lower thigh	1½	2	7	
10. Rabbit	Mangled thigh	2	2½	24	
11. Cat	Crushed thigh	1½	2	36	
12. Cat	Mangled thigh	2	2½		5 hrs.
13. Rabbit	Mangled thigh	2	3	24	
14. Rabbit	Crushed thigh	1	2		4 hrs.

This typical experiment clearly indicates that the shock syndrome embraces two distinct phases; first, the toxins liberated by the disintegration of dead cells; and secondly, the marked splanchnic stasis.

The fourteen experiments tabulated in the following protocol were carried out in a manner similar to the experiment reported above. After constricting the animal's leg with an elastic ligature, the injury was produced either by incision, mangling or clamps. Varying intervals were then permitted for cell necrosis to take place. The absorption symptoms usually appear soon after the release of the ligature, if cell necrosis is well established. In all

animals after shock syndrome was established, sections of the viscera were secured and immediately frozen, fixed and stained. The specimens were obtained in some cases before the death of the animal and in other cases after death.

The pathological findings in traumatic shock vary in degree but the primary change is the stasis observed in the splanchnic area, in the upper alimentary tract including the liver and lungs. This stasis is particularly noted in the portal zone of the liver; in the mucosa and submucosa of the upper alimentary tract and pulmonary arterial zone of the lungs. It is this congestion in the splanchnic area which is repsonsible for the fall in blood pressure and temperature and for the acidosis and metabolic failure. Examination of brain and nerve tissue immediately before or after death showed no changes which indicates that nervous manifestations play either a very small part or no part in the phenomenon of shock. "La Stupor" of Perigoff or "Topor" and "commotion" of Larry are secondary phenomena following the wake of the primary blood stasis.

It is perhaps well in this connection to point out that Raymonde, in 1909, tied off the circulation of the hind legs of a rabbit causing autolysis of the tissues. On reestablishing the circulation, there immediately followed dyspnea, rapid pulse, drop in temperature and other shock symptoms. Why shock followed in this experiment is evident from my above explanation. By interrupting the circulation, Raymonde caused autolysis of the tissue below the ligature and as the poisonous autolyzed products entered into the circulation, after releasing the ligature, the shock syndrome followed.

TREATMENT.

The above investigations clearly indicate that two factors underly the production of shock. The first factor is the blood stasis in the splanchnic area. It must be remembered that we are not dealing with mere congestion but with a state actually approaching coagulation. In other words, the circulation of the blood not only comes to a standstill in the splanchnic area, but that the viscosity of this fluid becomes so high, that on cutting a blood vessel in this area the blood will not run out, but will remain in the vessel.

The second factor is the production of toxins resulting from tissue disintegration. These toxins are produced by the action of ferments on the necrosed cells; shock being produced when these toxins enter the circulation.

It is evident, therefore, that the treatment in traumatic shock, in order to be successful, must aim (1) *to remove the blood stasis of the splanchic area and* (2) *to neutralize the toxins which are poisoning the patient.*

This is precisely the principle of the author's treatment. To remove the blood stasis in the splanchnic area, heat is employed. This is based on one of the principles of colloidal reactions. To illustrate: If gelatin is coagulated in a test tube, we can bring about a reversal of the colloidal reaction, *i. e.* we can cause the gelatin to become liquid again, by the simple application of heat. In the same way, by applying heat to the partly coagulated blood in the splanchnic area, we help to cause the blood to become fluid again.

In cases of shock, heat to be effective must be applied as nearly in direct contact with the splanchnic area as possible. The application of hot water bottles to the surface of the body is too remote to be of value, even though they are applied to the abdominal wall. I have long advocated the use of small thin rubber hot water sacs introduced into the abdomen during surgical operations. The rubber surface is preferable to the injurious gauze, as it causes less trauma to the peritoneum and provides a more constant heat, which to be effective must be of high temperature as well as directly applied.

Where the abdomen is not opened the next approach to the splanchnic area is through the stomach. The small rubber sac described is attached to a double recurrent rubber tube and introduced into the stomach. The heat is maintained continuously by a constant infow and outflow as I described in 1896. The heat not only reaches the liver by the gastric veins but the thoracic area through the esophagus is more or less directly affected, thus preventing stagnation in the lung capillaries. These methods can be used throughout surgical operations and have been found to lessen the danger from anesthesia.

The colon is the next valuable avenue for heat application for the splanchnic area. Hot water introduced into the colon during surgical operations is not always practicable, but the small hot water bags introduced into the colon can be beneficially used, though heat applied here is not always as effective as by the more direct route, the esophagus and stomach. I have for many years advocated the use of the continuous irrigation of the colon (with the double recurrent tube, giving water of high temperature followed by cold; then repeated) in operative or accident cases and infections of various types. As a control to regulate the amount of water the outlet tube is connected with a

vacuum bottle at the bedside which does not allow the colon to be overfilled.

The heat and absorption of the water have been shown to be of great value in all cases of shock and infection. The idea of the absorption of water alone without the heat led to the adoption of this method as the "Murphy drip." The danger of the injection of water by the colon, subcutaneously, or intravenously, was shown early in this work, and hence caution must be maintained by the proper dosage of the fluid intake. The value of this continuous fluid absorption and persistent heat within the abdominal area with the hot water bag will be more appreciated now that we know through our researches in colloidal chemistry that heat dissociates an absorption compound which occurs in the "colloidal complexes" in the animal organism in shock and infection. The application of heat to the soles of the feet has the advantage of being more direct in affecting the splanchnic area than when applied to the trunk, for the blood in the plantar veins when heated is carried directly by anastomosis through the hemorrhoidal vein into the splanchnic area, and portal vein of the liver.

Having outlined my procedure for overcoming the splanchnic stasis, our next problem is to neutralize the toxins which result from cell necrosis. This is brought about by the employment of a specific immune horse serum. The serum is produced by immunizing horses with properly prepared human autolyzed tissue protein. My procedure is described in detail in another place.* Suffice it to say in this connection, that if autolyzed human tissue is injected into horses from time to time, for a period of about six months, the animals develop in their blood specific antibodies against human products of tissue autolysis. Such immune serum, when subcutaneously injected in patients suffering from traumatic shock, has given, in the hands of the author, remarkably favorable results.

It will be recalled that the underlying difficulty in cell necrosis, is the fact that iso-autolyzed tissue resulting from the necrosed cells, enter the circulation and poison the patient. A serum therefore, which contains antibodies against human autolyzed tissue is, in the opinion of the author, the only logical treatment against the poisonous autolyzed tissue resulting from cell necrosis.

SUMMARY.

Traumatic Shock, according to the author, is the result of two underlying factors. (1) Marked stasis in the splanchnic area. (2) Toxemia resulting from autolization products of Cell Necrosis.

The method of treatment is primarily directed against the above two factors. (1) The splanchnic stasis is overcome by heat, in accordance with a well established principle of colloidal reactions. (2) The poisoning caused by products of cell necrosis is overcome by means of an immune serum which contains antibodies against human autolyzed tissue.

14 EAST 53rd STR.

* Medical Record March 2d, 1919.

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THE AMERICAN ASSOCIATION OF ANESTHETISTS WILL MEET IN NEW ORLEANS, APRIL 26-27, 1920, THE FIRST TWO DAYS OF A. M. A. WEEK. THIS—THE EIGHTH ANNUAL MEETING—WILL BE THE FIRST ANESTHETIC RALLY EVER HELD IN THE SOUTH AND IT IS HOPED THAT SOUTHERN ANESTHETISTS WILL PROMOTE THE INTERESTS OF THEIR SPECIALTY BY COOPERATING IN MAKING THIS MEETING A SUCCESS.

THE FOLLOWING WELL-KNOWN AUTHORITIES HAVE ALREADY CONSENTED TO PRESENT PAPERS—DRS. ALBERT H. MILLER, JAMES T. GWATHMEY, E. M. PRINCE, ANDRE CROTTI, CARROLL W. ALLEN, WALTER LATHROP, ANSEL CAINE, GEORGE PINESS, JOHN J. BUETTNER, E. I. McKESSON.

FOR FURTHER INFORMATION, APPLICATIONS FOR MEMBERSHIP AND PLACES ON THE PROGRAM, ADDRESS F. H. McMECHAN, M. D., SEC'Y, AVON LAKE, OHIO.

EXPERIMENTAL SURGICAL SHOCK.*

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It is my purpose to review briefly in this article the results of the investigations of experimental surgical shock with special reference to those phrases that have a bearing on its relation to anesthesia. While the review is not complete, it will include what is now considered the most important conclusion with regard to the condition.

Very few subjects have received such renewed impetus for investigation as has surgical shock. When I first became interested in shock in 1912 there were not fifty articles dealing with any phase of the subject in a comprehensive manner. In the last few years the number has more than quadrupled, and in the enormous amount of work that has been done a few new facts of great importance have been discovered. Much of the recent experimental work, however, has been a reduplication of the work of earlier investigators. There are still many unsolved problems in connection with the condition which the surgeon diagnoses shock.

In order intelligently to evaluate the results of experimental investigation of surgical shock, two points, which I have repeatedly emphasized, should be noted. (1) The condition termed shock by the surgeon is undoubtedly due to a large number of causes, and (2) experimentally it is very difficult to reproduce the environment and all the phenomena which the surgeon calls shock. [8] [9] [10] [11] and [12]. While the clinical picture and the resulting condition may be quite similar, the causative factors are undoubtedly different in many of the cases diagnosed as shock. The experimental production of a condition which fulfills the clinical diagnosis of shock is very limited and it must be conceded that experimental investigation has duplicated but few of the conditions of shock which the surgeon sees. In general, most of the experimental work has concerned the methods of production and treatment of low blood pressure.

THE ANESTHETIST AND SHOCK.

The anesthetist is interested in surgical shock because, (1) a patient may develop the condition during or following operation, and (2) it may be necessary to give an anesthetic to a patient already in shock. The experimental investigator has been able to learn more of these problems in which the anesthetist is interested than of many of the other conditions which the surgeon terms shock.

*Read during the Seventh Annual Meeting of the American Association of Anesthetists, at Atlantic City, June 9-10, 1919. From the Division of Experimental Surgery and Pathology, Mayo Clinic.

The possible causes of a patient's developing the clinical sign of shock during or immediately following an operation may be included in four groups: (1) preoperative condition, (2) anesthetic, (3) trauma and exposure incident to the operation, and (4) hemorrhage. Other factors are involved but most of them fall within one of these divisions.

It is well known that the preoperative condition determines, largely, the manner in which a patient will react to procedures incident to an operation. There are some experimental data concerning this. For instance the clinical observations have been parallelled to a certain extent by the finding that dogs with distemper will develop the signs of shock after exposure of the abdominal viscera sooner than normal animals, [5] [14]. A fat patient usually withstands operation poorly, and it seems to be true after abdominal traumatization that a very fat dog will develop the sign of shock more readily than a normal one. The poor reaction of the patient who has been purged intensively may seemingly be reproduced experimentally in animals.

The effects of the anesthetic and its relation to shock are complicated [10] [13]. In general their relationship depends on the direct action of the anesthetic and the indirect results of its action. Both of these depend on many other factors, such as the kind of anesthetic, the method of administration, the amount of the anesthetic, and the depth of anesthesia. Low ether tensions, just sufficient to produce narcosis, will not lower the blood pressure in a normal animal even after many hours, and they do not, as nearly as could be determined, predispose the animal to shock. The signs of shock can readily be produced by high tensions of ether. Furthermore, an animal that has been deeply etherized for a short time will develop the signs of shock following exposure of the abdominal viscera seemingly quicker than a normal animal.

The relation of shock to the trauma and to exposure incident to the operation depends on many factors. The most important of these are the site of operation, the character of the operation, and the duration of the operative procedure.

Hemorrhage is a factor which complicates a majority of clinical reports of shock. While many undoubted cases of surgical shock occur in which hemorrhage could not have been a factor, it has been present in many cases. I have been able to demonstrate this relationship between shock and hemorrhage from the experimental standpoint [8] [9].

The question of whether a patient in shock should be given an anesthetic and operated is still unsettled. Anesthetists and surgeons of large ex-

perience may be found on the affirmative and on the negative side. The experimental investigator has not been able definitely to settle this question but the weight of experimental data seems opposed to operative interference in shock when such interference is not absolutely essential to save life.

CORROBORATION OF EARLIER CONCLUSIONS.

In general, my earlier conclusions with regard to experimental shock have been corroborated in the whole or in part by recent investigators. Briefly, the most important of these conclusions are:

1. Clinically, certain cases of shock develop so quickly after the exciting agent that it seems the condition can only be due to a primary impairment of the nervous system. So far it has been possible to produce such a condition experimentally in but a few instances, and in these the experimental production was associated with inhibition. It would seem that inhibition is of more importance than excitation.

2. A condition simulating clinical shock, which developes sometime after the exciting agent, can be produced experimentally by diverse means. The only method which could be comparable with regard to precedure is by exposure of the abdominal viscera. Of such a condition produced experimentally the following facts are known: (a) The vasomotor center is not the primary cause, although it is probably impaired by the condition of low blood pressure[6 8], (b) the cardio inhibitory center is not primarily impaired[8], (c) the heart is capable of performing its work if enough blood is supplied to it although it undoubtedly is affected by the long continued condition of low blood pressure[2 8], (d) the condition is not due to a primary disturbance of respiration[8], (e) the condition appears to be due to a loss of circulating fluid[8 9], (f) the process as determined in the condition of experimental shock produced by exposure of the abdominal viscera can best be described by quoting from one of my previous articles[10].

"When the great delicate vascular area of the viscera is first exposed to the air, changes of temperature and handling, there is an immediate dilatation of all the arterioles in the exposed area. Rarely a short period of construction precedes the dilatation. As a result of this dilatation of the splanchnic arterioles blood pressure decreases. The splanchnic capillaries and veins are markedly distended, which may be due to one or all of the following causes: A local inhibition of vasomotor tone, an active dilatation, changes in abdominal pressure, and venous obstruction. On the whole, the process resembles the first stage of acute inflammation and does not appear to differ essentially from the phenomena as observed in the classical experiments on the subject. After this initial fall in blood pressure the condition of the animal may remain stationary or even slightly improve. However, as the loss of tone and paralysis of all the tissue involved take place, the blood pressure progressively falls, the temperature becomes subnormal and the animal develops profound shock. The loss of circulatory fluid and changes in temperature quickly imperil the life of the cells of the rest of the organism and death usually results from anemia of the medullary centers, particularly the respiratory. At the time the viscera are exposed and during the period that shock is developing, the vasamotor center increases in tone and the untraumatized arteries constrict. The amount of this constriction depends on their previous condition and the degree of splanchnic dilatation. During this time the center will usually respond to reflex stimulation and asphyxia, which demonstrates that it is still active although not functionating to its maximum extent. When the state of shock is fully developed it is usually, but not always, possible to obtain a response of the center, due to the long-continued low blood pressure or to the fact that all untraumatized arteries are constricted to their maximum extent, or that the great splanchnic area through which most reflex responses of blood pressure are produced is completely paralyzed."

Several important advances have recently been made in the treatment of shock, both by clinical and experimental investigation. I shall briefly review some of my previous work on the subject [11 13].

The treatment of shock may be divided into (1) general measures, (2) use of drugs, and (3) attempts to restore fluid volume. Some of the general measures, such as applying heat, etc., are universally practiced and both clinically and experimentally have been found of value. The use of drugs either the stimulants, of which strychnin is an example, or the vasoconstrictors, such as adrenalin, has not been shown to be of much value in experimental shock. An anesthetist's careful investigation of the use of these drugs in known and controlled cases of shock would be of great value. Many artificial fluids have been developed for infusion in the treatment of shock. Chief of these are (1) sodium chlorid, physiologic and hypertonic, (2) sodium bicarbonate or sodium carbonate (Fisher's solution)[3], (3) glucose, (4) sodium sulphate, (5) cane sugar, (6) gelatin (Hogan's solution)[7], (7) acacia (Bayliss' solution)[1], and (8) combinations

of these, as acacia, glucose, and sodium sulphate [13], acacia and glucose[2], etc. It may be concluded that the so-called colloidal solutions, those containing acacia and gelatin give the best results; the addition of glucose to the solution definitely emphasizes its value. The alkalin solutions are of more value than physiologic sodium chlorid solution, and a hypertonic sodium chlorid solution produces better results than a physiologic one. None of the artificial solutions produce as good results as blood. Experimentally blood serum has given as good results as whole blood.

Discussion.

From this brief review of the known facts concerning experimental surgical shock and its treatment, and from clinical investigation, it seems that the following discussion of clinical shock is justified.

All cases of shock may be divided into two general groups: those which follow immediately after the exciting agent, and those in which a time interval occurs between the development of the condition and the trauma.

It would seem that most of the cases in the first group, which includes most of the classical examples of shock given in the literature, are dependent more or less primarily on a reaction of the nervous system. If the primary factor in these cases is the nervous system, inhibition would seem to be of more importance than excitation. I have shown experimentally that under certain conditions inhibitory stimuli will produce death. It is reasonable to suppose that under various other conditions and other stimuli an acute condition can be produced.

The primary factors of a majority of cases of surgical shock are quite varied but a uniform end result is produced which probably accounts for their common symptoms. This end result seems to be a loss of circulating fluid. Under normal conditions the changes in the permeability of the cells, their water content, etc., are such that a sufficient and practically constant volume of fluid is furnished the blood. The mechanism of fluid volume is so regulated that the fluid intake, fluid outgo, mass of circulating fluid and fluid content of the tissue cells are mutually interdependent. Changes in any of these factors must throw into action a mechanism which attempts to compensate for these changes. In shock we may have any one or more of these factors primarily or secondarily involved and it seems to me that most of the known facts of experimental and clinical shock can be explained in terms of impairment of these factors.

A few instances are cited in which a decrease in fluid intake apparently is of importance in shock. It seems to be a clinical fact that patients who have vomited persistently before operation do not react well after operation. From my experiments it appears that the withdrawal of fluid for a few hours before beginning an experiment predisposed the animal to shock. Further data is being obtained on this point. In contrast to this one may compare the patient who receives a hyperdermoclysis or proctoclysis during or immediately after operation.

There are a few instances of changes in fluid output which may have a bearing on shock. It is a well known observation that in experimental shock due to exposure of the abdomnial viscera a large amount of fluid is lost from the exposed visceral surface. This no doubt plays but a slight part in clinical shock. The poor reaction of the purged patient is probably due to the loss of fluid. The fluid lost through excessive sweating of the patient undergoing operation is also a factor in shock.

Probably the majority of cases of surgical shock are due to a decrease of circulatory fluid brought about by external loss (hemorrhage) or an internal loss following damage to tissue cells. I believe then an explation of most cases of shock will involve one or both of these factors.

The relation of external loss of fluid (hemorrhage) to shock has been repeatedly discussed but it is of so much importance that it should be reviewed, briefly, at least. I have shown that a hemorrhage during anesthesia will produce all the signs of shock except, in some instances that of low blood pressure[8]. Furthermore in shock due to exposure of the abdominal viscera the loss of circulating fluid is sufficient to produce all the signs of shock[9]. Both of these findings have been corroborated [4]. It would seem that the common symptoms of shock and hemorrhage are dependent on the common loss of circulatory fluid.

Shock and Hemorrhage.

Recently I have performed some experiments which again emphasize the relationship between shock and hemorrhage. If an etherized animal is bled repeatedly of a small amount of blood it is found that at first each hemorrhage produces a slight decrease in blood pressure which is quickly corrected. However, as the small hemorrhages are repeated a point is finally reached at which the pressure does not fully recover, and later does not recover at all; there is a total failure of compensation of the vasomotor mechanism and the mechanism for controlling fluid volume. If only one or two small hemorrhages are produced and the abdominal viscera are then exposed for a short time it is found that although compensation occurs before the

trauma it does not afterward. The exposure of the abdominal viscera produced the same effect as the repeated hemorrhages. If the abdominal viscera of an etherized animal are exposed for a very short time and then replaced the condition of the animal remains good and shock does not develop. However, if at the time the viscera are replaced the animal is also bled a small amount, much too small to produce a permanent effect by itself, the animal is very apt to develop the symptoms of shock. The experiment may be varied by substituting some other procedure, such as deep etherization, for the abdominal trauma and the small hemorrhage will usually produce a marked effect.

These experiments would seem to show that the effect of hemorrhage depends in a large measure on various factors. A combination of deep anesthesia, operative trauma and hemorrhage is probably the most common cause of operative shock.

Internal loss of tissue fluid due to tissue injury seems to be a most potent cause of shock. When body cells are damaged their ability to control their water content and permeability seems also to be impaired. If the amount of tissue damaged is sufficient the entire mechanism for controlling fluid volume is impaired and the decreased circulation produces all the clinical signs of shock. It seems that many forms of tissue injury will produce this result. The initial factors may be quite varied. As was previously stated, in experimental work a decrease in blood supply to a relatively large volume of tissue is the most common factor. Excessive heat and cold also will damage tissue and produce shock. The employment of drugs, toxic substances, probably some even arising from injured tissue cells themselves, will produce the same end result[12].

BLOOD PRESSURE.

Few surgeons will make a diagnosis of shock in a case in which a low blood pressure is not present and it is undoubtedly true that the low blood pressure is the most important complication to treat. Nevertheless, as Meltzer first pointed out, a patient may have all the signs of shock without a low blood pressure[15]. I was able to produce such a condition experimentally both by exposure of the abdominal viscera and by hemorrhage[8]. These results have been corroborated[2] [4]. It seems that in such cases vasomtor compensation has been able to maintain blood pressure against the decreasing blood volume, although at the expense of the blood supply to the tissues.

POSTOPERATIVE SHOCK.

Probably no better example of the application of the data and theories derived from the work on experimental shock can be made than an attempt to explain the failure of reaction after operation which is termed postoperative shock. Such a condition is undoubtedly quite complex but a partial analysis of the possible factors involved can be made; it may best be discussed by a consideration of the factors involved before operation, during operation and after operation.

Before operation the most important points to consider are those discussed under fluid intake. If the fluid content of the patient is not up to normal, due either to factors associated with the pathologic condition present, vomiting, fever, etc., or to faulty preparation, purging, etc.

During operation the most important factors enter. The anesthetic is of great importance and may aid in producing the condition either by the direct depressing action of the drug, or by the indirect result of this action. The direct action produces depression of the circulation and respiration and a loss of muscle tone. These in turn produce a decrease in tissue nutrition and resulting tissue damage. The amount of damage seems to be proportional to the initial irregularities of the anesthetic and the depth of anesthesia. Hyperpnea and asphyxia are to be considered but probably most important is whether or not the anesthetic is pushed to the point where a decreased respiratory pump and loss of muscle tone fails completely to return the blood to the right side of the heart.

The part operative trauma plays varies but in general it is proportional to, (1) the degree of hemostasis, (2) exposure of the abdominal viscera, (3) changes in normal pressure relations, as opening abdominal and thoracic cavities, and (4) the production of nerve reflexes.

Postoperatively the most important factors are restoration of fluid volume, and elimination of the anesthetic. From the experimental standpoint it seems to me that the most important result of administrating carbon dioxid is the stimulation of respiration, thus more quickly eliminating the anesthetic.

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A STUDY OF THE TOXIC EFFECT OF GENERAL ANESTHETICS IN NATURALLY NEPHROPATHIC ANIMALS; AND PREVENTION OF THE TOXIC ACTION.*

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During the past few years several investigations have pointed out the frequency with which naturally acquired nephropathic processes occur in the kidneys of dogs. Such observations have been made by Ophuls[1], by Pearce[2], and more recently by Dayton[3].

A few years ago a rather extensive study of these naturally nephropathic processes was taken up in this laboratory, with the object in view of classifying such conditions and in the second place of studying the naturally acquired kidney injuries from a point of view of the physiology of the kidney and finally for using such material in which to produce some acute injury by various nephrotoxic agents.

In the purely pathological study, this chronic kidney material was found to fall in a general class of chronic kidney injuries, in which a productive inflammatory reaction occurs, leading to some form of secondarily contracted kidney. In two of the animals, the changes in the kidney, coupled with the changes in the vascular tissue of the kidney and the vascular changes in general, permitted a classification of the kidneys from these animals as primarily contracted kidneys.

In the first and larger group of chonic nephropathies, the initial injury appeared quite clearly to take place in the glomeruli, leading to a chronic glomerulo nephritis. In such lesions it was impossible to separate the capsular from the intracapillary changes. In these kidneys the tubular epithelium was well preserved. This observation of the lack of correlation between the degree of chronic glomeruli injury and tubular injury has very recently been pointed out by Stengel, Austin and Jonas[4], as occurring in certain chronic nephropathies in human material. From this very brief account of the chronic naturally acquired pathology, this group of animals, it will be seen, offers an excellent opportuniity to study the functional capacity of the kidney when its vascular mechanism is severely injured with the epithelial element of the kidney only slightly participating in the damage, and the material also furnishes the opportunity of studying the effect of the susceptibility of the kidney to certain injurious agents, such as anesthetics, not only from a pathological point of view, but from the standpoint of the kidney's function.

Observations of Naturally Nephropathic Animals Prior to an Anesthetic.

Twenty-one animals have been used in this series of experiments. The animals were kept in metabolism cages, given 500 cc. of water daily by stomach tube, and fed on a diet consisting of bread with a small amount of cooked meat. The urine was examined twice in each 24-hour period. The examination consisted in the ordinary qualitative examination for albumin, acetone, diacetic acid and the centrifugilized urines were examined for tube casts. The Marriott methods were used in determining the reserve alkali of the blood and the carbon dioxid tension of alveolar air.

Blood urea examinations were made by the method of Marshall, as modified by Van Slyke and Cullen[5], and the phenolsulphonephthalein test was conducted according to the method outlined by Rowntree and Geraghty[6]. These examinations have shown a trace of albumin in the urine from the various animals. The number of casts in the different urines has varied very much—from only a few hyaline casts in several fields to numerous granular casts in the urine of other animals. The urine failed to show either the presence of acetone or diacetic acid. The reserve alkali in all of the animals, with one exception, has varied within the range of normality—from 8.0 to 8.15. In the exception to this, the reserve alkali was 7.9, and it is of some interest that the urine of this animal showed the largest amount of albumin—1.2 grams—and the casts in the urine were very numerous and principally of the granular type. The carbon

*Read during the Seventh Annual Meeting of the American Association of Anesthetists, at Atlantic City, Jnue 9-10, 1919. From the Laboratory of Pharmacology, University of North Carolina.

dioxid tension of alveolar air has shown a correlation with the reserve alkali of the blood. The blood urea determinations have varied from 0.015 to 0.028 per cent. The output of phthalein has varied from a minimum of 52 to a maximum of 69 per cent.

From the above outlined findings, taken in conjunction with the pathology of the kidney as shown at autopsy, it seems permissible to conclude that these animals had a chronic glomerulo nephritis resulting in a type of secondarily contracted kidney, which is comparable not only in its pathology but in the blood of urine findings with similar conditions that occur in the human material.

The animals of this group were anesthetized either by morphin-ether, or by Grehants anesthetic—the active anesthetic constitutent of which is cloroform. Each animal so anesthetized was controlled by a normal animal that had been subjected to the same examination as outlined for the nephropathic dogs. The anesthesia for the control and nephropathic animals lasted 1½ hours, and at each half-hour interval during the anesthesia the urine was collected and measured, and the blood of the animals examined by the method indicated for its reserve alkali content. At such half-hour intervals, different diuretic substances were given the animals, and their effect on the functional response of the kidney noted in the output of urine during the following half-hour period. The diuretic solutions employed were as follows:

Theobromine, 1 per cent.
Caffine, 1 per cent.
A 0.9 per cent solution of urea.
A 20 per cent solution of glucose.
Pitruitrin 0.5 cc. per animal.

The difference in response of the normal control animal, as compared with a naturally nephropathic animal during the course of the anesthesia, is very striking. All of the control animals were freely diuretic after the establishment of a satisfactory state of surgical anesthesia. The output of the urine varied from two to eight drops per minute. The reserve alkali of these animals and the tension of alveolar air carbon dioxid was normal at this period of the anesthesia, and remained normal for the hour and a half of the experiment.

When such animals were given any of the diuretic solutions previously mentioned, there occurred an increase in the formation of urine. The output was greatest from the glucose, and from the pitruitrin.

When a similar degree of surgical anesthesia had been produced in the naturally nephropathic animals, the result was a harp reduction in the output of urine. Only one of the animals was forming urine at this early stage of the experiment, and the output in this animal was only two drops per minute. The remainder of the naturally nephropathic animals at this period of the experiment had become anuric. During the course of the experiment, the reserve alkali of the blood showed a progressive reduction in all of the animals, so that by the end of the hour and a half period of the experiment, the reserve alkali readings varied between 7.8 to the very low figure of 7.45. During this period, the same diuretic solutions were given these animals as were administered to the control animals. The nephropathic animals which at the commencement of the experiment was forming two drops of urine per minute, responded half an hour later to the theobromine with an increase of urine to ten drops. All of the other animals remained non-responsive to the various diuretic solutions. The state of anuria which was established by the time these animals had become completely anesthetized persisted throughout the experiment, and was uninfluenced by those diuretic solutions which in the normal control animals were of distinct diuretic value.

These observations permit rather clearly of the following deductions:

The use of an anesthetic in such naturally nephropathic animals leads to a progressive reduction in the reserve alkali of an animal's blood, and associated with this change in the acid base equilibrium there occurs a rapid reduction in the formation of urine, or the establishment of a state of anuria which is uninfluenced by various diuretic solutions.

Prevention of the Toxic Action.

With these observations in mind, an attempt has been made by the use of an alkaline solution given intravenously, to protect the kidney of such naturally nephropathic animals against the toxic effect of an anesthetic.

In this series of experiments, 12 naturally nephropathic animals have been used, and a similar number of naturally nephropathic animals were employed for controls. The control animals were given, an hour prior to the anesthetic, 25 cc. per kilogram of a .09 per cent solution of sodium chlorid, while the naturally nephropathic animals, which were not to serve as controls, were given a similar amount of sodium carbonate solution equimollecular with a 0.9 per cent solution of sodium chlorid. The animals were then anesthetized by either morphin ether or Grehant's anesthetic and observations made at half-hour intervals for the duration of the experiment, which lasted an hour and half similar to the observations previously detailed.

The naturally nephropathic animals which served

as controls, and which received intravenously the sodium chlorid solution, became anuric by the time a state of satisfactory surgical anesthesia had been produced. The reserve alkali of the blood showed a reduction which varied between 7.9 to 7.8, and during the course of the anesthesia a progressive reduction in the alkali reserve occurred, so that at the termination of the experiment, the alkali reserve varied between 7.7 to 7.6. All of these animals remained anuric during the course of the experiment, and they were furthermore not responsive to diuretic solutions of theobromine, urea, glucose, and pituitrin.

The naturally nephropathic animals which received the sodium carbonate protection were all diuretic at the completion of the anesthesia. The reserve alkali varied between 8.25 to 8.15. During the course of the anesthesia these protected animals also showed the effect of the anesthetic in reducing their alkali reserve, so that at the termination of the experiment, the alkali reserve in these protected animals varied between 8 to 7.85. Those animals of the group which showed the least reduction in their alkali reserve—a reduction not under 7.9, remained diuretic during the course of the experiment, and were furthermore responsive to these diuretic solutions which were of no value in the control animals. However, those animals that received the sodium carbonate and which during the anesthetic showed a reduction in their alkali reserve to a point as low as 7.85, became anuric and were non-responsive to the diuretic solutions.

These observations permit a continuation of the observations made with the first group of nephropathic animals:

1. That the use of an anesthetic effects a reduction in the alkali reserve of the blood, which is very marked in naturally nephopathic animals.

2. That such a reduction is associated with a decrease in kidney function.

3. That if the alkali reserve of the blood during an anesthetic can be kept above 7.9, the animals not only remain diuretic but they remain responsive to the various diuretic solutions.

The histological study of the kidneys of these animals which have either remained diuretic during the experiments or have become anuric, show that in the former group there is but little evidence of degeneration of the tubular epithelium, and but a small amount of fat in the apithelium. The animals, however, which have shown a marked reduction in alkali reserve, and have become anuric and non-responsive to diuretics, show a severe swelling and necrosis of the tubular epithelium, especially that of the convoluted tubules, and the occurrence of large amounts of fat in the tubular epithelium, especially that of the ascending limb of Henle's loop.

This experimental study apparently points very clearly to the danger of an anesthetic in a naturally nephropathic animal. It furthermore shows that this danger is definitely associated with the ability of the anesthetic in a given animal to induce a disturbance in the acid-base equilibrium of the animal's blood in favor of its hydrogen ion content, and it furthermore points out that it is possible, by the judicious use of an alkaline solution, to maintain in some degree a normal acid-base equilibrium against the anesthetic, and that if this can be accomplished, the degenerative changes in the kidney, affecting especially the epithelium of the convoluted tubules, may be prevented, and the functional capacity of the kidney in some measure retained.

SAFETY FACTORS IN THE TEAM-WORK OF OPERATOR AND ANESTHETIST.*

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"There is nothing new under the sun" is an old and very true adage. While there are new things arising frequently, there are often new applications for old things. I beg leave to ask your indulgence if the thoughts expressed in this paper are not entirely new. The purpose is chiefly to emphasize and lay special stress on ideas and facts already known, but not sufficiently heeded by all who should heed them. A mere perusal of the title of this paper suggests the presence of danger. How fortunate that we should live in an age that makes use of the slogan "Safety First." The railroads have their "Stop, Look and Listen" signs, which we have all encountered while touring. We have received the admonition or noticed the sign of "Watch your Step;" the streets of the cities have their traffic officers or signs "Keep to the Right;" machine shops have been compelled by law to safeguard all machinery. In short in civil life it has become not alone a necessity but a habit to safeguard life where there is any possible danger. Have we, as members of the medical profession, taken all the precautions we could or should have taken? To this we can answer "Yes" and "No."

Inasmuch as this paper deals only with operator and anesthetist, the remarks will apply only to

*Read during the Fifth Annual Meeting of the Interstate Association of Anesthetists, before a Joint Session with the American Association of Obstetricians and Gynecologists, at Cincinnati, September 15-17, 1919. Chairman's Address.

those members. Surgery, properly considered, is a therapeutic procedure. There is always an element of danger in connection with it, even though a general anesthetic is not administered. The dangers attending surgery and anesthesia, have in great part, been recognized and much has been done to overcome and prevent them and investigations keep up to prevent and minimize those which have not yet been conquered. We are all proud to note the safety signs that have thus far been erected to guide surgeons and anesthetists, in order that the surgical patient may have a safe journey for the relief and eventual cure of his ailment.

NEED OF EDUCATION.

To those who have given thought to the matter of safety, there always arises the short-sightedness of our medical colleges in not properly training the medical student in these branches. We appreciate that an anesthetic is administered to allay pain and overcome muscular contractions. The fundamental teaching for this art, as Flagg calls it, must come from the medical school. Dr. Isabel Herb, in her paper, "The Anesthetist on the Hospital Staff," says: "The slogan to be adopted, the safety device to prevent anesthetic deaths, is education." Dr. W. D. Gatch, in his paper "Anesthesia in Curriculum and Clinic" very forcibly paints the defects in teaching. He suggests a co-relation of the subjects so that there is a very forceful application of the subject of anesthesia in conjunction with physiology, pharmacology, internal medicine and operative surgery. As Gatch further says, "Where would the advances in surgery be if it were not for the advances in anesthesia?"

The surgeon requires education just as much as the anesthetist. The real surgeon seeks intensive training under an able leader before he branches out for himself. It is not altogether how good an operation can be performed, as it is, how much good will come from the operation if performed. The proper training of each and the working together of both will result in good team work.

VALUE OF TEAM WORK.

One can state with perfect safety that team work in surgery has its advantages. It is no longer an experiment but rather a well-established fact. Encouragement is given the anesthetist, who being recognized as a full-fledged specialist, assumes his place in the surgical team, not alone as the one who administers the anesthetic, but as a consultant. He helps weigh in the balance, the advisability of operating, the selection of the time that will be safest to operate, and makes the choice of the anesthetic. He helps prepare the patient for operation. To do this the anesthetist must be a trained physician.

A further object of this trained surgical team is, not alone to prevent death but to overcome or at any rate, minimize the discomforts attending surgical operations. This training having brought about specialization, in turn encourages further study and the discovery of new and hidden paths that would otherwise be unknown.

We cannot, to-day, overlook the fact that, meetings of this kind, where two or more special branches of medicine meet in joint session must bring benefit to all concerned. It should be encouraged, because in open sessions of this kind the short-comings of all can be brought out and remedies suggested. This will exemplify that old saying, "Always speak well of yourself, the other fellow will take care of your faults."

DUTY OF THE ANESTHETIST.

As was stated before, the duty of the anesthetist is not merely to administer the anesthetic agent, but to help prepare the patient for the operation. When should he begin and what preparation is needed? When it is possible the anesthetist should begin his work when the surgeon has decided that an operation is needed. It is advisable to have the patient in the hospital at least 48 hours before the operation. For some cases it may take several days to a number of weeks to properly prepare the patient. A full physical examination of the patient is advisable. With this there should be a quantitative and qualitative examination of the urine. We are no longer satisfied with a simple chemical examination of the urine. A full knowledge of the quantity of the urine for 24 hours, specific gravity, presence or absence of albumen, sugar, acetone, diacetic acid and casts. When possible a functional test should be made. The examination for acetone before operation is too often neglected. It should be made a routine practice.

A full blood examination including the clotting time of the blood is another safeguard. While it is perhaps the rare thing to find a delayed clotting time, we may save ourselves considerable anxiety if this test is made before the operation. The work of McKesson, Miller and others on "Blood Pressure," show the great importance of this valuable, but neglected examination. The work of Polak on "Blood Pressure" and "Phthalein Output" shows very conclusively a safety first sign if properly heeded. All these examinations are given, not for the purpose of placing a mountainous obstacle to surgery, but merely to indicate some of the safety signs that will spell success to the surgeon and

gain the best end results for the patient. At this point, let me speak a word in favor of the great work done by the clinical laboratory. All too little use is made of this branch in our preoperative preparation of the patient. One of the most trying and obstinate obstacles we at times encounter is acidosis. The laboratory can be of great help to us in this condition and proper diet and medication will overcome or mitigate this condition to such an extent that surgery can be undertaken with perfect safety, and with greater comfort than would otherwise be possible. The laboratory work in diabetic cases is of inestimable value.

We often meet the argument against this preliminary stay in the hospital, that due to the great nervousness of the patient, it would react unfavorably. This is true, if no explanation is given the patient, why this extra time is needed. A great trouble is that the thinking is too often done for the patient and not by the patient. Outside of the great good to the patient by these examinations, there is another derived benefit, *viz.*, becoming hospitally acclimated and becoming acquainted with the nurse who is to have charge of the case.

It is especially in genito urinary surgery where this preoperative care and preparation of patient shows up so vividly. With this preoperative care. patients that formerly were doomed to die without operation, are now made fit subjects for surgery that affords not only relief, but oft times, cure. At any rate, comforts are given where only misery was possible before.

Another great advance in preoperative preparation is the care given the gastro intestinal tract. No longer is the surgical patient starved and purged. How true the comparison of surgical patient with the athlete in preparation for a race. We can only say that common sense, rather than the continuation of old time ideas without reason, prevails. The better physical condition the patient is in at time of operation, the happier, and shorter the convalescence.

By giving the patient the regular diet the day before the operation, supplemented as suggested by Glagg, with ½ pound of chocolates, it helps to neutralize the acidosis caused by the anesthetic.

Preoperative Medication.

Purging, or active catharsis, is not only useless, but one of the great causes of postoperative gas pains and distension. The patient should have ample sleep and rest before the operation. If necessary some sedative as bromide, chloretone or veronal should be given the night before to produce a good sleep.

Shall we use preoperative medication? While there is a great deal of negative evidence, I believe there is far more positive evidence that it should be used. It has been my rule for a long time to use the preliminary medication in the majority of cases. When I use it I give morphin 1/6 gr., or pantopon 1/3 gr., with atropin 1/150 gr., in ether cases and hysocin 1/150 gr., in gas-oxygen cases. While very occasionally I have seen a slowing of the respiration due to the morphin, I have never regretted its use in a single case. The value of morphin or pantopon, both before and after operation, is too little appreciated. There may be a marked disadvantage with inexperienced anesthetists when this preoperative medication is used, but with the experienced anesthetist, who relies on no one sign or symptom to indicate the condition of the patient, there can be no disadvantage. If there is an idiosyncrasy or a known contra-indication no preliminary narcotic medication is used. The length of the operation and the type of operation also influence its use. My choice of late, has been to use the medication sub-lingually, rather than hypermatically. The action is fully as good and the psychic effect on the patient is also very marked.

Choice of the Anesthetic.

The next thought after proper preparation of the patient and designation for time of operation will be the choice of the anesthetic. It is really surprising to read and hear the differences of opinion as to the best anesthetic agent. Statistics are of no avail in helping us to decide. It almost seems that certain sections have fads and fancies in the choice of anesthetics. It is a known fact that all anesthetic agents are poisons. It is also a fact that only experienced physicians should administer these agents. With the inexperienced we know that ether is the safest anesthetic. With the experienced, nitrous oxid and oxygen is the safest. It is also the pleasantest and has the least after effects. Those who use gas-oxygen to any extent agree that there are practically no contra-indications to its use. A short time ago, I read a paper in which the chief contra-indication to gas-oxygen was noted to be the surgeon. That still holds true where the surgeon is not accustomed to work with gas-oxygen anesthesia. The surgeon who has been in the habit of working with a deep ether anesthesia must be taught to work with gas-oxygen to have it work successfully. It is really a re-education of the surgeon. Once accustomed to its use he will work with as much ease and comfort as he did before with ether. The appealing factor in this change

is the patient. One always hears how pleasant it is to go under, how pleasant the awakening. The surgeon is surprised at the good condition of the patient, even after a long operation. It is conceded that there is not the relaxation with gas-oxygen that there is with ether. In a certain class of cases a small amount of ether may be necessary to produce the desired amount of relaxation. The success comes in the team work of operator and anesthetist. It must be a give and take proposition. The greatest fault with gas-oxygen will be found in abdominal surgery. In great part this will be overcome if the operator will make a sufficiently large incision to begin with, so that he can make all necessary examinations without being compelled to use great force in inserting his hand into the abdomen. The position of the patient on the table to insure the greatest amount of relaxation to the involved parts is another great aid. Guthrie and others have commented most favorably on the use of the slight Trendelenburg position when starting the anesthetic. This has its advantages in a number of cases. On the other hand there is great danger in extreme Trendelenburg, especially if long continued. Good judgment must prevail in knowing the patient and how much Trendelenburg position will be tolerated and for how long. Proper relaxation of the effected parts may be obtained by pillows, sandbags or with the newer type of operating table by adjustment. This relaxation helps, not alone during the operation but also on closure of incision.

The one great field that is surely but slowly adopting gas-oxygen is obstetrics. Chloroform has done noble work in obstetrics. It will never be totally replaced by gas-oxygen or any other anesthetic. It is a very valuable anesthetic agent when properly used and in properly selected cases. Ether will, of necessity, be the agent most largely used. It has its indications and in many cases its advantages over any other anesthetic. No doubt the difference in cost has been a drawback to the greater use of nitrous oxid. Greater experience has thus been gained with ether and when properly administered it compares quite favorably with gas-oxygen.

Sonnoform, which is a combination of ethyl chlorid, methyl chlorid and ethyl bromid, is largely used by dentists. It is of great value in short anesthesias where it will give greater relaxation than gas-oxygen. It is also largely used to induce ether anesthesia in place of gas. It has a further advantage in not requiring any large apparatus for its administration.

Ethyl chlorid has its advocates who are as enthusiastic as others are for ether or gas. Its chief use is for short operations or as a preliminary to ether especially with children.

The success of the administration of any anesthetic agent lies absolutely with the administrator rather than with the agent or apparatus used.

HANDLING EMERGENCIES.

The use of oxygen with any anesthetic is of great value. It increases the safety without diminishing the anesthetic value. It is a stabilizer of blood pressure, diminishes or overcomes nausea and vomiting and facilitates an earlier return to consciousness. In obstetrics, I have found it of great value in resusciation of the new-born babe.

Emergencies are always to be considered and are best met when there is team work. It may be necessary in some cases to transfuse before operation. The experienced anesthetist watches the patient so closely at all times that he can give ample warning to the operator to speed-up or even cease his work, if the patient's condition becomes unfavorable. If blood pressure observations are taken during an operation one will find evidence of danger long before it comes on and will be able to meet it, almost before it arrives. The anesthetist should know what emergency measures should be applied if occasion demands. The operator should at all times, use such speed as is commensurate with safety and good technic. All bleeding should be controlled at once. Unnecessary bruising of tissue should be avoided.

Surgical shock is a nightmare, that as yet has not been fully solved. The theory of Cannon, that it is due to absorbed toxines, arising from the bruised tissues, may explain why cases of long duration with rough handling suffer shock. We know that hemorrhage is one of the causes of shock, and nerve irritation another cause, but there are cases that as yet have received no satisfactory explanation for the appearance of shock. While no doubt further investigation will eventually solve this problem it behooves us in the meantime to consider all the supposed causes of shock and try to avoid them.

POSTOPERATIVE CARE.

What care will we now give the patient following the completion of the operation? After the dressings are applied, the patient, properly protected, is taken back to bed. The bed should be warm, hot water bottles should be placed about the patient to keep up heat, the room should be bright enough to recognize change of color in patient. The position of the patient in bed should be such as to

afford the greatest comfort to the patient, ample pillows being supplied to produce this condition Enough anodyne should be ordered to give relief from pain for the first 48 hours. Water should be given as soon as the consciousness is fully established. Rectal injections of alkaline solutions with or without glucose should be ordered if the case demand the same. Feeding should be started at a very early period. Careful watching of the patient is necessary to detect change of color or pulse rate. Absolute quiet should be enforced for the first few days.

If the anesthetic has been properly administered a very early return to consciousness is assured. This means that there is a minimum amount of anesthetic for the patient to eliminate, there will be less time required in watching till full return of consciousness, and the discomforts attending return of consciousness will be practically nil.

In conclusion I wish to emphasize, first: a change in college curriculum to meet suggested requirements. Second: a greater preoperative care and examination of patient. Third: greater team work in our hospitals.

In limiting my remarks to operator and anesthetist, it was not with the idea of minimizing the value of other members who are a part of the surgical team. There must be a concerted action of all in order to have success.

1208 SOUTH SALINA ST.

SURGICAL BARRAGE.*

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The greatest protective development in modern warfare was the so-called *Barrage*. To be effective, every minute detail was worked out with the greatest precision. Started a few seconds too early or too late meant not only a possible failure, but even worse, destruction of one part of an army by another part of the same army. Team work was absolutely essential.

A *Surgical Barrage* may be defined as the process of surrounding the surgical patient with all the skill and refinement known to specialists in the various departments of medicine and surgery during the *Preoperative, Operative, and Postoperative Periods.* Surrounded with such a barrage, the patient may reasonably anticipate the lowest possible mortality rate, with the shortest and least uncomfortable morbidity period, the latter factor becoming more and more the aim of every thoughtful surgeon.

It is our hope to briefly, yet concisely bring before you certain of the elements making up this barrage, basing our conclusions not upon theory but experience.

VALUE OF STANDARDIZATION.

First of all, we have already noticed a marked advance in the safety line to the patient by the work started by the American College of Surgeons, in the Standardization of Hospitals. This not only mean a general awakening of hospital managements, thereby increasing the efficiency of the hospital, but is destined to have an enormous influence in standardizing surgery itself. Hospital managements when selecting a staff are beginning to give occasional thoughts to some other qualifications aside from a reckoning of the number of pay patients the proposed member has been rushing to the hospital. It is to be regretted that, in the past, the latter motive has all too frequently actuated the selection of staff members by many institutions, especially those of a sectarian type.

We regret, however, that the officers of the College have apparently overlooked one important factor in their otherwise valuable standardization work, and in a few instances have even given their individual influence to the lowering of standards. We refer to professional anesthesia which matter we will discuss further along in the paper.

PSYCHIC INFLUENCE.

In the field of Gynecology much is gained for the patient as well as for the profession, by a close alliance of surgeon and psychiatrist. The patient has been taught so many foolish and untrue things about herself; and the relations of her sex organs to the entire endocrine system as well as to the nervous system, are so complex that frequent consultations with a properly trained neurologist will often avoid useless and even harmful surgery.

The Gynecologist probably comes into contact with a higher percentage of chronically ill patients than does any other surgeon. He must therefore consider with unusual care the Preoperative and Postoperative Periods. Everything possible must be done not only to raise the patient's physical condition, but her psychology must receive special attention. She should reach the hospital and be received without an unpleasant experience whenever possible. Immediate preoperative purgation is to be avoided. Fluids, especially alkalines, are given

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freely. A good night's rest is assured by the use of sedatives and if absolutely necessary, some narcotic.

We assume that a positive diagnosis has been made if such is a human possibility, and the work well planned before the hour of operating. This bespeaks smooth, rapid surgery, without bungling haste. All known means should be used to measure the patient's resistance, including carefully acquired knowledge of the kidney function and cardio-vascular system, as well as metabolism in general. We still continue to attribute much importance to the *Pulse Pressure Ratio,* a term used to indicate the relation between the pulse pressure and the diastolic pressure, and which we discussed at length in a former paper read before this society.

VALUE OF THE PULSE PRESSURE RATIO.

We have made systematic use of the principle ever since that time, just as we did for some years previous to the report. All cases are recorded and the records comprise most interesting data for study. Dr. Miller of Providence, R. I., has recently reported, following our plan in 1,000 consecutive cases, and stated that he has found it correct and of much value. In the same article, Dr. Miller puts forth an idea that we have adopted and found to have much to commend it. He divides his cases into three classes as follows:

The good risks: Patients free from organic disease, whose surgical condition is not especially serious.

The fair risks: Patients suffering from organic disease, but whose surgical condition is not especially serious.

The poor risks: Patients whose surgical condition is so serious or so far advanced as likely to result in a fatality.

All patients of the first class are expected to recover. If a fatality should occur from among this class the case should be carefully gone over to determine whether the preoperative prognosis was in error or if the work of the surgical team is blamable for the fatality.

As an example for the second class, an operation for appendicitis might be urgently required in the case of a patient whom the examination showed to be affected with diabetes. If coma and death follow such operation, the fatality will be considered beyond human control. If no examination and no prognosis had been made, the necessity for a lame explanation of the result would have arisen.

THE QUESTION OF ANESTHESIA.

With this classification, we are now ready to consider the question of anesthesia. Shall it be Local or General, and if the latter what agent is to to be used? Any surgeon who insists that there is but one form of anesthesia or only one anesthetic, is too partisan to be a real student. If one classifies his patients as above, and seriously considers the sort of an operation he is going to do, he will soon find need of several forms of anesthesia and several anesthetic agents.

It is not our purpose to discuss at this time the question of *Local anesthesia,* but before passing it, we wish it to be understood that in our judgment it may be used in the future much more than it has been in the past, owing to great improvement in the technic of its administration. (Personally if I were without the services of a professional anesthetist who was especially skilled in the use of nitrous oxid oxygen, I would do a larger percentage of my work under Local.—Moots.)

Ether has practically solved the question of immediate mortality rate, when properly administered, and is certainly the safest general anesthetic agent in unskilled hands. It also makes toward easy surgery. There are a few factors about it, however, that do not please the surgeon who is looking for ideal anesthesia. The odor while taking as well as following the operation certainly does not leave pleasant memories on the mind of the patient; the awful nausea; the interference with the function of cells and organs as proven by the laboratory; delayed deaths, not conscientiously attributable to the surgical traumatism alone are things we like to avoid.

In 1907 we became interested in nitrous oxid-oxygen. At first our difficulties were many; ignorance of the necessity of joint study and cooperation between surgeon and professional anesthetist, poorly devised equipment for administrtion, lack of experience in the signs of anesthesia produced by this agent, lack of ability on my own part to operate with minimum traumatism, being the principle causes in the light of our present knowledge. With these propositions mastered, we are today happy in the conscious enjoyment of a technic which leaves little to be desired. *However, the kind of anesthesia and the agent used to procure it is secondary in importance to that of the anesthetist. In fact, a professional anesthetist we believe to be the most important factor in the Surgical Barrage.*

We have considered all the arguments ever offered in favor of the non-professional anesthetist, and in times past were inclined to admit that in some of them there existed a partial truth, but with our profession home from the war and such a goodly percentage ready to devote their lives to the study

and practice of anesthesia, there now exists no reason for any surgeon who is unselfishly devoted to raising the standard of hospitals and surgery, to encourage in any way non-professional anesthesia. All pro-arguments when well disected fade away, and a new light upon the screen shows the real cause of the blustering arguments, viz: The surgeon in the big clinics was not happy in the thought of a fair fee going individually to a professional anesthetist and the surgeon in the smaller cities hoped to encourage the family physician to send more cases by having him give the anesthetic. And it is quite probable that the surgeon has sometimes used the matter of the anesthesia as an excuse to give the practitioner a fee somewhat larger than the skilled anesthetist would have charged the patient.

The question of the advisability of nurses administering anesthetics has recently been brought up before us. It is our conclusion after what we feel to be an impartial study of the subject that while some nurses may be taught to administer the safer agents in uncomplicated cases in a manner highly satisfactory to the operator, yet the principle is fundamentally wrong for reasons so numerous that we hesitate to embody them in this paper. We still maintain that the administration of a general anesthetic is the giving of the most powerful and dangerous drug at the most perilous time of the patient's life. During any major operation the anesthetist may be called upon to make one or several new diagnoses and prognoses, and this certainly constitutes the practice of medicine and even demands unusual skill.

Few surgeons know much about the subject of anesthesia because the subject has not been properly taught in our colleges and hospitals. Our hopes for this subject, therefore, lie in the encouragement we give the specialty of professional anesthetists. To them we must look for advances in their line. They must be considered in our discussions during the Preoperative as well as the Operative Period. We commend the report of the Committee of Anesthesia of the American Medical Association to the effect that: "Every Hospital, certainly every large hospital, should have as a regular member of its staff an attending anesthetist whose authority in his special branch should be as complete as that of the attending surgeons in theirs."

What is meant by a qualified, professional anesthetist?

For answer, we quote from Dr. Isabella C. Herb: "The qualified anesthetist is one who is capable of making a physical examination of the patient, can interpret laboratory findings, is familiar with operative requirements, able to weigh the evidence and select the most suitable anesthetic and the method of its administration for the particular case under consideration. These qualifications require not only a thorough medical education but special training in the theory and practice of anesthesia as complete as is required in the field of surgery or its correlated specialities."

It was with extreme regret upon our part, that upon our return from the war-ridden countries, we found the legislature of our own great state, Ohio, legalizing non-professional anesthesia. Already we hear the jeers of the non-medical cults concerning the all too apparent insincerity of some of our leaders regarding their desire to really raise the standard of the medical profession.

THE TIME FACTOR.

Another factor of much importance to the patient is that of the length of time required for her operation. While not advocating bungling haste, it is certainly safe to conclude that the briefest possible time only should be utilized for any surgical procedure. All other factors being equal, her morbidity period should be in ratio to the operating period.

There is a certain length of time, varying in every case, that may be termed the "Safety Period" for operation in that particular case. The operator who absolutely knows anatomy and can easily operate speedily will therefore save many border line cases that would be lost by a slow operator who would require time far beyond that "Safety Period."

SUTURES.

We have had no experience either during our Navy service nor in private work that have caused us to change our attitude upon the question of sutures. They should be absorbable, of the smallest possible size necessary to carry out their function, and so prepared as to be absorbed as soon as their function is ended.

SHOCK.

The subject of shock is an important one and should be considered in every abdominal section. Many brilliant discusions of the causes of this condition are to be found in the recent literature, and will not be reiterated here. We believe, however, that much practical good may be gained at this time, by keeping constantly in mind three factors as follows: Pathology, Surgery and Anesthesia.

Cardio-Vascular Depression being the outstanding symptom of the condition known as shock, it is reasonable to start with the proposition that what ever means enables us to determine the very beginning of this condition, is of the greatest importance.

Now when a cardio-vascular system is reacting normally, an increased pulse rate is accompanied by an increased systolic and diastolic blood pressures, and vice-versa. The pulse pressure is roughly half as great as the diastolic pressure and is the most direct evidence we have of the amplitude of the heart contraction, the best evidence of effective blood movement. In normal sleep, the pulse rate and blood pressures are lowered but their normal relationships are maintained; so are they in an ideal anesthesia.

But during surgical operations, so many factors enter to disturb the normal reaction of the circulation that we may have many combinations, with almost never a true *stimulation*, but very frequently a *depression* of the circulatory system. The changes occur so frequently with sometimes disastrous and sometimes innocent results, that it is most desirable to be able to differentiate between them and to anticipate their onset.

BLOOD PRESSURE RULES.

There is no form of anesthesia, there is no age of patient, there is no type of operation in which one expects to see an elevation of blood pressures during the operation. Our fears are from low blood pressures, rapid pulse rate, and heart fatigue.

Circulatory Depression or Decompensation is best divided for surgical operation into three degrees:

1. Safe. 10 to 15 per cent. increase on pulse rate without change in pressure. 10 to 15 per cent. decrease in blood pressures without change in pulse rate.

2. Dangerous. 15 to 25 per cent. increase in pulse rate with 15 to 25 per cent. decrease in blood pressures.

3. Fatal. Progressively increasing pulse rate above 100 with progressively falling blood pressures of 80 or less systolic and 20 or less pulse pressure, for more than 20 minutes.

The first degree is never fatal but may gradually merge into the second degree. The second degree, beginning shock, may be regarded as dangerous in the sense that it exhausts the heart and disarms it for defense against continued low blood pressures.

The third degree is always dangerous to the life of the patient. A vicious circle is established consisting of the low blood pressure, the reduced heart nourishment which in turn still further reduces the blood pressure, and so on progressively. This usually developes within 20 minutes after the third degree depression occurs and when once well established proves fatal at once or at most within three days. The time in which shock proves fatal depends upon the cardiac muscle reserve and the effectiveness of the treatment employed. Third degree depression may be present in a patient without the usual alarming signs, but after the vicious circle becomes established, evidences of shock become well marked.

VALUF OF BLOOD PRESSURE READINGS.

With the palpating finger, no matter how skilled, one cannot determine all the characteristics of the pulse or the pulse pressures with sufficient accuracy to be of much prognostic value as to the onset and degree of circulatory depression during a surgical operation.

Blood pressures and pulse determinations every few minutes during all of the more serious operations as well as in many of the so-called minor cases are a part of the duties of every anesthetist. The information regarding the patient's fitness for the operation, his reaction to certain procedures and the immediate prognosis can be gained in no other way with the same degree of accuracy

The procedure is made convenient and easy by fastening the blood pressure cuff to the right arm and snugly binding the stethescope below it with elastic webbing. Readings can then be made at will without disturbing sterile sheets and without losing the continuity of anesthesia.

PRESERVING MUSCLE TONE.

A suitable graphic chart is preferable as a record because the tendencies of the circulation are readily compared from time to time and because the prognosis based upon these tendencies and the character of operative work to follow, can be more accurately made.

Where nitrous oxid-oxygen was available in skilled hands the war has corroborated our previous observations that this form of narcosis is one of the best shock prophylactics we have.

It is not remarkable that nitrous oxid-oxygen should be safer in shock and in preventing shock than other anesthetics when one recalls the fact that muscle cannot be paralyzed with it.

The greatest responsibility of the anesthetist is to avoid relative over-dosing of the patient in an effort to please the surgeon who may be demanding a flabby musculature.

The relaxation is not confined to straited muscles of the abdomen and extremeties, but extends to the straited muscle of the heart. The effect is at once reflected by the pulse pressure and if pushed too far the diastolic pressure is also decreased showing the action upon smooth muscle as well.

The clinical study of blood pressure has convinced us that the final factor in shock is muscular exhaustion or an interference with muscular ac-

tion. One thing is most apparent, the average patient having been profoundly anesthetized for extreme relaxation, is half shocked, a second degree depression, and it often takes but little trauma to complete the picture of third degree depression.

We might go on discussing the relation of pathology, of surgery, of anesthesia to circulatory depression and nearly all we could say would be old and familiar to all. Yet it would be of no value to Mr. or Mrs. John Doe if blood pressure determinations were not made during his or her operation to check up the technic of every member of the operating team that no unnecessary damage be done. In other words let us practice some of our knowledge in preventing shock.

SUMMARY.

We believe that there is a general knowledge of the advantage of professional anesthesia and that this factor will soon be within the reach of the majority of good surgeons. If, added to this great aid, the surgeon considers well the psychology of the patient; avoids active preoperative purgation; keeps the patient warm, and has her well filled with fluids; discreetly uses morphin; understands the pathology before him; does rapid, bloodless untraumatic surgery, he surrounds the patient with an effective barrage.

The Postoperative Period is characterized by the absence of meddlesome medication; by keeping the body warm and properly supplied with fluids, especially alkaline and often adding dextrose; all wound-dressings being exceedingly light and cool; absolute quiet for infected and traumatized cases while clean adbominal and pelvic cases should be moved about and gotten-up much earlier than formerly supposed. The opportunity offered the surgeon himself to benefit the patient by his advice and suggestions during this period, should be used with much thought and intelligent discretion.

THE ANESTHETISTS IN A NUMBER OF THE LARGER CITIES, SUCH AS NEW YORK, LOUISVILLE, TOLEDO, PROVIDENCE, SEATTLE, KANSAS CITY, SAN FRANCISCO AND LOS ANGELES, HAVE ORGANIZED LOCALLY. WHEREVER THIS HAS BEEN DONE, THE SPECIALTY OF ANESTHESIA IS IN A FLOURISHING CONDITION. THERE ARE MANY OTHER LARGE CITIES IN WHICH THERE ARE ENOUGH ANESTHETISTS TO PERFECT A LOCAL ORGANIZATION OF THE SPECIALTY TO THE ADVANTAGE OF ALL CONCERNED. IT IS TO BE HOPED THAT DURING 1920 THE ORGANIZATION OF THE SPECIALTY OF ANESTHESIA WILL GO FORWARD BY LEAPS AND BOUNDS. THIS MESSAGE IS MEANT FOR YOU! IT IS UP TO YOU TO SEE THAT YOUR COMMUNITY HAS THE BEST ANESTHETIC SERVICE OBTAINABLE AND THAT THERE ARE A SUFFICIENT NUMBER OF EXPERT ANESTHETISTS TO MEET ALL DEMANDS.

SOMNOFORM (ANESTHETIC MIXTURE) A NEGLECTED ANESTHETIC FOR ORAL SURGERY.*

OEL E. LANPHEAR, D.D.S.,
KALAMAZOO, MICH.

When man found that the interfering pain, which hindered even the most skillful operation from even approximating good work, could be short-circuited, human life, liberty, and the pursuit of happiness were ushered into a new era, kaleidescopic in its limitless variations. The field of human progress was immeasurably broadened with the discovery of anesthetics suitable for subduing any of the endless varieties of pains to which human flesh is heir. Nitrous oxid and oxygen was projected on the stage of Human Endeavor in the alleviative field of Medicine to play the stellar role. It was cast in the hero's part and the studious thinking minds of today pay tribute to its ability, though they seek an anesthetic which can be given with less strain to the anesthetist, one that can be handled without a complicated machine, one with easy access to the source of supply. The most distinguished minds of all ages have endeavored to aid surgery to obtain perfect operative results in the smallest amount of time with the modicum of risk and discomfort both to patient and operator.

A limited number of men have mastered the technique of the evanescent or rapidly eliminated type of anesthetics. Few thoroughly understand nitrous oxid and oxygen and somnoform in their practical application and extreme value in the various fields of operative procedure under the multitudinous taxing psychic and physical conditions or seek to become past masters in their use.

The accursed apathy of the amateur anesthetist keeps him a tyro. He captures a single idea, puts it on a single track, or monorail and endeavors to operate without a gyroscope or stabilizer. These single track monorail anesthetists endeavor to create by word or otherwise oftentimes, (with their own lack of results as an example) many prejudices against the good work of nitrous oxide and oxygen and somnoform. Our many good earnest workers along this special line should be safeguarded against these amateurs in this most fruitful field of professional endeavor. I am a very strong advocate of the meritorious, tested agents, and they should be upheld by the anesthetist.

FIELD OF NERVE BLOCKING.

Local anesthesia produced by various chemical

*Read before the Section on Oral Surgery and Dentistry of the Interstate Association of Anesthetists, during the Fifth Annual Meeting, at Cincinnati, Sepember 15-17, 1919.

compounds of varying strength and osmotic tension are injected or projected into normal, inflamed, and pathological, human tissues with equal facility to say nothing of the psychological and physical condition of the patient. Many of the misguided amateurs are injecting unknown drugs into unknown spaces with befogged ideas of the anatomical structures upon which they are operating and erroneously terming the precedure nerve blocking. The saner minds are seeking a reaction. They are endeavoring to create a predominence of sane, scientific aseptic methods with due anatomical precision.

True nerve blocking by a skilled operator is to be indorsed. The nerve blocking anesthetist who inserts the needle into the deep tissues blocking the various nerve trunks, including the extraoral and intraoral methods, must thoroughly understand what he is doing. He must possess a thorough knowledge of the anatomy of the parts he is injecting and must understand the true meaning of asepsis, as well as possessing a thorough knowledge of the physiologic and toxic action of the agent employed. Careless, infective and defective blocking should be universally discouraged.

ADVANTAGES OF SOMNOFORM.

Close beside nitrous oxid and oxygen on our stage of Human Endeavor, we find somnoform in a star role of great worth. Somnoform most nearly approximates the ideal of the efficient anesthetic, simple equipment, ease of operation, speed of recovery of patient, uniformly good operative results. Somnoform is of great value in selective cases, for ease of operating, simplicity of machine and manipulation, comfort of patient, absence of venous swelling, speed of relaxation, speed of recovery, duration of narcosis and analgesia and transportation facilities for remote territories.

Somnoform as used at the present time is composed of ethyl chlorid, 83 per cent.; metyl chlorid, 16 per cent., and ethyl bromid, 1 per cent.

Quoting freely from DeFord, Henahan, Crile and others, anesthetic mixture is invaluable in facilitating the induction and obviating the long induction period of excitement for etherization. In operating on the upper air tract ethyl chlorid in combination is especially to be recommended because no asphyxia is developed. There is no sensation of suffocation, no cyanosis, no sterterous breathing, and if administered with percentage admixtures of atmospheric air, or oxygen, jactitation or spasm of the extremities of masseters rarely presents.

Rolland found in the combination of methyl chlorid, ethyl chlorid, and ethyl bromid an anesthetic which enters the circulation with practically the rapidity of oxygen, has an almost instantaneous effect on the nervous system and tissue cells, and on the cessation of its administration is equally as rapidly eliminated without causing any untoward complications.

PRELIMINARIES.

If you please the patient comes without a full meal, She is ushered into the dressing room where a trained nurse assists in the preparation, which is physical and psychological. One point is never allow her to be left to herself on account of mental forebodings.

Henehan holds that the aim is to have the patient as comfortable as possible and completely relaxed. Attention should be paid to this, for if the patient remains tense with the muscles contracted the tendency is to become more so, requiring a much deeper and more prolonged anesthesia. At this point it is well for the anesthetist to reassure the patient that all the nurse has promised of the virtues of the anesthetic is perfectly correct and that the outlook for the success of the operation is most promising. It is necessary also to come to an understanding with the patient regarding the respiration before inducing analgesia or anesthesia. Many persons carry a small volume of oxygen to the lungs at each inhalation and believe that their noses have little use for nasal breathing. Thus, little somnoform reaches the alveoli of the lungs. Observe carefully the volume of nasal breathing the patient does with the lips closed. The nose should be free and the patient convinced that he can breathe through the nose, especially when a nasal inhaler is used. While deep breathing is neither required nor desirable, moderate respiratory excursions are necessary for the proper induction and maintenance of anesthesia.

REPEATED ANESTHESIA.

During oral operations it may become necessary to repeat the anesthetic at the same sitting because of foreign bodies getting beyond the barriers erected to keep them from the throat or various other reasons. When necessary to repeat the anesthetic at the same sitting, sufficient time should elapse for the patient to fully recover from the effects of the first administration and at this time the mouth should be cleansed and care taken to control hemorrhage; if hemorrhage cannot be controlled by packing, the patient may be kept from smallowing blood by aspirating it mechanically. Continuous anesthesia is preferable to repeated administrations.

SIGNS OF ANESTHESIA.

The signs of somnoform anesthesia are very

easily worked out by the anesthetist who gives the vapor deliberately and notes the progress until he develops an "anesthetic sense of intuition," which will enable him to adapt the technic of administration not only to the given patient, but also to all the exigencies of the operative procedure in hand. The stages are apparently parallel and are similar to ether. Often the patient breathes very irregularly until he loses consciousness, when the rhythmic breathing begins. The pupils dilate, do not react to light, and the eye lids pressed against the cornea fails to produce reaction and the eye balls become fixed.

METHOD OF ADMINISTRATION.

Absolute care must be exercised from the beginning of the anesthetic until the nasal mask has been removed that none of the valuable anesthetic—anesthetic that has not reached the lungs—is allowed to escape. Operators must have well adapted inhalers and handle the valve with precision. With the patient in readiness we turn to one side and quietly break a capsule of somnoform on the gauze of the modified DeFord Inhaler, thus there is only somnoform vapor in the bag. Then deftly apply the inhaler to the face with the valve closed and a second capsule in place ready for snapping. Let only enough vapor escape at the first and second inhalations to anesthetize the olfactory nerve ends.

Then proceed with larger amounts, catching a part of each expiration and partly opening the valve for each inhalation until the bag is nearly full. It may be inadvisable to catch all of each exhalation. By the tenth inspiration the patient's entire breathing should be into the bag and the patient nearly ready for the operation. Endeavor to so use your anesthetic that you get a gradual progression into anesthesia from the first, disregarding the quantity of somnoform consumed. If we feel that one capsule will accomplish all work, very well. If intuition tells us that we are getting too much carbon dioxid in an individual case we allow the patient to inhale from the bag and exhale into the atmosphere until the volume in the bag is lessened to any point we wish. Then we can break the reserve capsule. If conditions are right the anesthetist's assistant immediately inserts another tube. For prolonged anesthesia in oral operations we now exchange the face piece for the nasal piece and so regulate our valves that we get free breathing enough to keep the patient narcotized. We should discourage the method so many use of carrying the patient through the preliminary stages at so rapid a pace, that the anesthetist cannot note the important stages as the patient passes under. For this method often gives us a deeper narcosis than is required or necessary for the surgical operation at hand.

ANESTHETIZING CHILDREN.

Oftentimes, children present very trying cases when persuasion is of no avail. If the operating room with its many distracting influences is the last straw or for other reasons it may be advisable to start our anesthetic in the anesthetic room by holding a small cotton roll saturated with oil of orange and ethyl chlorid under the nose while we are visiting with them, then we can proceed with the anesthetic of choice. Parents may wish that we work by force if necessary. If so, we close the valve in a Starck Inhaler, break one capsule of somnoform upon the gauze with the bag half full of pure oxygen, place a second capsule in position and put the face piece over the whole face and open the valve one-half of the opening. Endeavor to catch the next exhalation and then give the contents of bag until struggling is lessened. Then adjust the valve to secure a stage of anesthesia easily recognizable and proceed deliberately.

A DeFord Inhaler is easily modified to meet the requirements of an office by having an adaptor just in front of the valve in such a position that it is very easy to interchange the nasal and mouth piece of a machine used in that office. Thus the rubber fittings are always in A1 condition.

AFTER-CARE.

As soon as the operation is over and the patient can be left to his own resources, the gauze and inhaler should be removed and discarded and the rubber bag and the various rubber attachments sterilized by dry heat and imersion in a bichlorid of mercury solution. Both sides of the bag should be thoroughly dried and powdered with soap-stone, all excess of the powder being then removed. Unless this is done the rubber bag and the air cushion will rapidly deteriorate. The metal parts of the appliance should be sterilized by boiling.

CONCLUSIONS.

In a busy office a somnoform anesthesia can be given and the operation performed successfully with less time, skill, and patience than is necessary for a successful nerve blocking with fewer after pains. Somnoform does not necessitate the anatomical knowledge demanded by local anesthesia. For minor operations, at the bed-side somnoform is less cumbersome and more easily managed especially if the surgeon is called upon to perform the double role of anesthetist and surgeon, that is, for short operations like lancing a boil, extracting a tooth, or the short dressing of a wound. The anesthetic period allowed the operator with the analgesia period following is sufficient.

HANSELMAN BLDG.

Abstracts

A Résumé of the International Current Literature of Anesthesia and Analgesia

Modified Open Ether Anesthesia. J. W. SILK. *British Medical Journal,* May 24, 1919.

Silk uses a mixture consisting of 1 dram of chloroform and 32 drams of ether. The patient should have a preliminary injection of morphin (1/6 to 1/4 grain) and atropin (1/100 to 1/60 grain). The face pad and mask is the same as for open ether, the mask being closely applied to the face and face pad from the very beginning. The liquid is used exactly as if it consisted of ether alone, the presence of the small quantity of chloroform being ignored. During induction the liquid is poured freely onto the mask just to the verge of resentment, but when consciousness and reflexes are abolished, it will suffice to reduce the supply to the dropping stage. The combination has given excellent results.

Shock Due to Mechanical Limitation of Blood Flow. J. ERLANGER and H. S. GASSER, St. Louis. *American Journal of Physiology,* Baltimore, July 1, 1919.

An examination was made by Erlanger and Gasser of the mechanical changes in the circulation occurring in shock as induced by procedures directly involving the abdominal viscera, that is to say, in the type of shock most commonly investigated. Another method of inducing shock was the so-called mechanical shock of Janeway and Jackson. These investigators studied the effect of temporary partial occlusion of the inferior vena cava. They found that properly graded temporary partial obstruction of the inferior vena cava above the liver or of the aorta beyond the origin of the left subclavian artery eventually results in the development of a condition closely resembling traumatic shock. They are convinced that the failure of the circulation after both manipulations is in part certainly due to the consequence of the sequestration of corpuscles in the capillaries and venules, and that if back pressure in the veins, such as is produced by caval obstruction, is a factor in the development of this state of affairs in the capillaries and veins, it is not an essential one. The fact that the vasomotor mechanism need not be involved (as for example in aortic obstruction) renders it unnecessary to invoke failure of a nervous venopressor mechanism to explain the fullness of the capillaries and venules. It can be explained on the basis either of the change in character of the blood stream, or respiratory and nutritional changes in the vessel walls or, and more probably, of both.

Circulatory Failure Due to Epinephrin. J. ERLANGER and H. S. GASSER, St. Louis. *American Journal of Physiology,* Baltimore, April 1, 1919.

The experiments reported by Erlanger and Gasser show that the injection of epinephrin for a period of from twenty to thirty minutes at such a rate as to maintain a high arterial pressure invariably constricts the arteries of both the somatic and the splanchnic areas. With large doses this constriction may be maximal and outlasts the injection period, it may be, for as long as two hours. This continued constriction is partly due to central action. After sufficiently large doses, the arterial pressure, barring occasional intercurrent phenomena, fall steadily and slowly until the animal dies. The jugular pressure, during or after large injections shows no constant alteration, at least not of a kind that indicates inefficiency of the heart. The heart may become irregular for a while and occasionally stop suddenly while the arterial pressure still is high. The respiration after large doses often is slowed and may suddenly or gradually fail. The portal pressure is increased, often markedly, during their injection, and may remain high subsequently; but not uncommonly it soon returns to the normal level. Evidence is presented indicating that accumulation of blood in the portal area as a result of the increased portal hepatic resistance is not in itself the cause of the failure of the circulation. The failure of the circulation is rather to be attributed to the extreme slowing of the blood flow throughout the body caused by the constricting action of the epinephrin of the arteries. It is concluded that the cause of the failure is the same as is operative after temporary partial obstruction of the vena cava or of the aorta.

Initiation of Wound Shock and Its Relation to Surgical Shock. E. M. COWELL. *Lancet,* London, July 26, 1919.

A number of points in connection with shock are emphasized by Cowell, such as the psychic aspect of the case and the loss of circulating fluid and body heat. He agrees with other observers that during operation in such cases, or where the anatomic interference contemplated is at all extensive, the surgeon should insist on gas and oxygen anesthesia either alone or combined with regional anesthesia. During the operation a falling pressure may be counteracted by giving from 500 or 1,000 c.c. of a 6 per cent. gum solution in physiologic solution of sodium chlorid. There is no evidence of any permanent benefit following the injection of any of the numerous drugs recommended from time to time.

Blood Regeneration and Bone Marrow Activity. Editorial, *Journal, American Medical Association,* August 16, 1919.

Although the length of life of the red cells of the blood is still unknown, there is no doubt that they undergo disintegration sooner or later. Sometimes their destruction is hastened by disease; sometimes the erythrocytes are lost to the body through hemorrhage. It becomes important at times, therefore, to learn to what extent reparative processes are taking place and whether red cells are being returned to the circulation. Microscopic examination of the blood during rapid regeneration of the erythrocytes reveals the presence of nucleated forms. Nucleated red cells have therefore been taken as "an inevitable feature of rapid blood degeneration." As Macleod[1] has pointed out, however, changes in the mode of red blood cell formation may be responsible for the nucleated forms.

Some time ago Warburg[2] demonstrated that whereas normal human blood consumes very little oxygen, blood such as that of birds, which contains nucleated erythrocytes, may evince a high oxygen absorption. Morawitz[3] has observed, however, that even in mammals blood obtained during the regeneration following an anemia may show an absorption of oxygen that cannot be accounted for by nucleated cells or by substances possibly dissolved in the plasma. The explanation seems now to have been furnished by Harrop[4] of the Medical Clinic at the Johns Hopkins Hospital, Baltimore. Starting with the assumption that the red cells in the blood which appear reticulated after certain methods of histologic staining are "youthful erythrocytes," Harrop has found that blood which contains abnormal numbers of them has an oxygen absorption proportional to the percentage of reticulated cells present. These two factors are interdependent; according to Harrop, both are due to the presence of abnormal numbers of youthful cells and both are probably rather accurate indicators of functional regeneration in the bone marrow and of the amount of blood regeneration. According to this latest American research, normal mature human erythrocytes have no oxygen consumption measurable by present methods. Furthermore, when it is measurably increased in the blood of individuals with anemia, the oxygen consumption has no direct relation to the severity of this symptom, and no constant relation to histologic abnormalities in the erythrocytes other than increases in the number of reticulated cells. A large proportion of all the nonnucleated red blood cells in the bone marrow are reticulated. Accordingly, the increase in the number of these forms, along with increase in the hemoglobin of the blood and a greater oxygen consumption thereby, is indicative of increased activity of the bone marrow.

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F. HOEFFER McMECHAN, A.M., M.D., *Editor*
Avon Lake, Ohio, U.S.A.

JANUARY. EDITORIALS. 1920.

RECOGNITION GIVEN INDIANAPOLIS ANESTHETISTS AND THE SPECIALITY OF ANESTHESIA.

The recent appointment of Drs. A. E. Guedel and Charles Cabalzer as consultant anesthetists to the staff of the Indianapolis City Hospital is significant. It is the first public recognition of anesthesia as a specialty in that city. Commenting on this matter Dr. S. E. Earp, editor of the Indianapolis *Medical Journal* in the November issue, writes as follows:

"Time was, not so long ago, when every physician would clip a pair of tonsils in his office and think nothing of it. This was then a part of the general practice of medicine. But gradually the importance of proper technic in this operation, and the acquisition of greater skill in its performance by men who had given the matter special study, has forced the operation of tonsillectomy into a field of special practice. Likewise have other specialties been borne. The diagnostician of internal medicine, the tuberculosis man, the serologist, the urologist and many others are specialists because they are better trained and have acquired more skill in their particular fields than the general physician. There is so much more to be learned about every branch of medicine than there was to be learned twenty years ago, that it is impossible for any one man to gather and retain an adequate knowledge of it all. Therefore the specialist. To learn thoroughly any one branch of medicine at this date is a task to tax the best of us, and to do it well leaves but little time for work in other branches.

"Now comes anesthesia. Its advancement in late years has been rapid. Anesthetic organizations have been formed. Special attention is given to anesthesia in some of the better journals that we read. Some of our best men are working for the advancement of good anesthesia. There are men in Indianapolis who have given much time and attention to this work and as a result, our city today stands as one of the foremost centers of the United States in this branch of medicine.

Formerly, say twelve years ago, in this community the administration of the anesthetic was commonly left to anyone who happened to be near, whether a nurse, a medical student or the family doctor. No attention was paid to it from a scientific standpoint. One surgeon would demand chloroform for all cases; another would demand ether for everyone. There was no attempt to select an anesthetic agent or method, which was particularly suited to the individual patient or operation. Then, if a patient had a heart lesion or albuminuria that patient was a bad risk and was frequently denied the benefit of a surgical operation. If a patient died under an anesthetic his death was said to be due to a bad heart or to status lymphaticus and it was assumed that his time had come; that he would have died just the same under any other anesthetic circumstances. Today this is changing. It will be some time before it has completely changed. No specialty was born in a day. But it is changing.

The special anesthetist, the man who has given long time and study to the perfection of his knowledge of this work, is among us and his presence is being felt. The technician in the administration of any anesthetic agent, he who has mastered the mechanics of it, and has gone no further, cannot be called an anesthetist. The anesthetist of the future shall be a physical diagnostician and shall be able to assist the surgeon in the selection of the anesthetic to be used and the manner of its application. He shall be able to assume all responsibility for the anesthetic. It is not uncommon even now for the surgeon to leave the selection and the administration of the anesthetic entirely to the anesthetist. The surgeon wants none of the responsibility of this work, where he can crawl from under it. It is the anesthetist in the future who shall take the bad surgical risk and develop it into the safest possible one for the condition. Patients who

are to be denied operation because of their inability to take a general anesthetic will be but few in number.

One of our anesthetists states that fully one-half of his work now comes from the patient, either direct or through the surgeon. This means that when there is to be an operation in any family, a careful and selected service in everything is desired. One of our surgeons who employs special anesthesia for most of his work states that in no case yet has the patient objected, after a brief explanation, to the extra expense of skilled anesthesia. Often now, the general practitioner over the state, when he refers a patient to the surgeons for operation, specifies the anesthetist to be employed in the case.

The day is passing when *anybody* can give the anesthetic. Recent advances in this work has made it a special practice worthy of our recognition. It is for the good of all medicine and surgery that this specialty be encouraged. Let us ask ourselves, "Were we to be operated upon who would give the anesthetic?" The question is at once answered. We want the skilled anesthetist for us and ours. Let us think of our patients with the same concern that we think of ourselves. Not only is it but fair to the patient: it is to our own advantage in every way.

In adding anesthesia to the staff of the Indianapolis City Hospital, are we leading the public, or are we supplying a public demand? In either case it is a step forward for medicine and surgery in our community."

THE QUESTION OF THE ANESTHETIST IN THE SURGICAL BARRAGE.

Speaking before the Joint Session of the Interstate Anesthetists and the American Association of Obstetricians and Gynecologists at Cincinnati, O., September 15, 1919, Dr. Charles W. Moots, of Toledo, O., emphasized anew that the professional anesthetist is the most important factor in the Surgical Barrage thrown about patients coming to operation for their protection. While Dr. Moots goes into details in his paper on this subject, published in this issue of The Supplement, the editor deems Dr. Moots such an authority in the matter of professional anesthesia that he is reprinting his pertinent remarks, editorially, so that their force and influence will have reiterated effect. Dr. Moots says:

"We have considered all the arguments ever offered in favor of the non-professional anesthetist, and in times past were inclined to admit that in some of them there existed a partial truth, but with our profession home from the war and such goodly percentage ready to devote their lives to the study and the practice of anesthesia, there now exists no reason for any surgeon, who is unselfishly devoted to raising the standard of hospitals and surgery, to encourage in any way non-professional anesthesia. All pro-arguments when well disected fade away and a new light upon the screen shows the real cause of the blustering, *viz.*: The surgeon in the big clinics was not happy in the thought of a fair fee going individually to a professional anesthetist and the surgeon in the smaller cities hoped to encourage the family physician to send more cases by having him give the anesthetic. And it is quite probable that the surgeon has some times used the matter of anesthesia as an excuse to give the practitioner a fee somewhat larger than the skilled anesthetist would have charged the patient.

"The question of the advisibility of nurses administering anesthetics has recently been brought up before us. It is our conclusion after what we feel to be an impartial study of the subject that while some nurses may be taught to administer the safer agents in uncomplicated cases in a manner highly satisfactory to the operator, yet the principle is fundamentally wrong for reasons so numerous that we hesitate to embody them in this paper. We still maintain that the administration of a general anesthetic is the giving of the most powerful and dangerous drug at the most perilous time of the patient's life. During any major operation the anesthetist may be called upon to make one or several new diagnoses and prognoses, and this certainly constitutes the practice of medicine and even demands unusual skill.

"Few surgeons know much about the subject of anesthesia because the subject has not been properly taught in our colleges and hospitals. Our hopes for this subject, therefore, lie in the encouragement we give the specialty of professional anesthetics. . . . . .

"It was with extreme regret upon our part, that upon our return from the war-ridden countries, we found the Legislature of our own great state, Ohio, legalizing non-professional anesthesia. Already we hear the jeers of the non-medical cults concerning the all too apparent insincerity of some of our leaders regarding their desire to really raise the standard of the medical profession."

In this connection it is interesting to know that the Chiropractors in Ohio are using this inconsistency of the medical profession to further their own legislative aims. Why deny Chiropractors

anything when lay anesthetists are legalized to trifle with life in its most perilous moments.

It is doubly interesting to know that in the great and glorious Commonwealth of Ohio, from the statistics of Drs. Salzer and Stewart that coroners', hospital and surgeons' figures all show a mortality rate of at least one death in every five hundred anesthesias, irrespective of the agent employed. It is to be hoped that coroners will presently demand an explanation for this state of affairs. It is no wonder with this prospect in view that the Southern California Association of Anesthetists is trying to protect the people of California from exploited lay anesthesia and anesthetists now being foisted on the country by nurse anesthetist mills in New York, Cleveland and Rochester.

The Editor also hopes that those who fostered the campaign against *fee splitting* will presently get busy in dealing with those who are charging professional anesthetic rates for camouflaged services and are putting the profits in their pockets. If the profession-at-large does not deal with these profiteers drastically some one else presently will.

Considerable interest is being shown on the Pacific Coast with regard to ridding the profession of lay practioners and technicians. In this connection the following resolution adopted unanimously by the Los Angeles County Medical Association, on October 16, 1919, is significant:

"Resolved, That the Los Angeles Medical Association go on record as in favor of the limitation of the practice of anesthesia to regularly licensed physicians and surgeons."—McM.

THE NATIONAL ANESTHESIA RESEARCH SOCIETY.

After several meetings to discuss ways and means of advancing the progress of anesthesia not only for the welfare of the public, but also of surgery and the specialty, a number of the forward-looking manufacturers of anesthetic agents and apparatus have formed a business organization with a limited appropriation for 1920 to establish the National Anesthesia Research Society in the hope that their efforts may eventually be broadened into an Anesthesia Foundation.

For the present all efforts will be directed toward the stimulation of research in anesthesia and it is confidently expected that those who are doing such research work will lend the prestige of their names to the roster of the Research Committee of which the Editor of the Supplement has accepted the Chairmanship and Dr. W. I. Jones, of Columbus, O., the Secretaryship.

A very broad program for ultimate accomplishment has been made a part of the By-Laws of the new organization and the details of this program will be announced in the next issue.

A canvass is now being made to interest research workers in becoming members of the Research Committee. This membership entails no responsibility other than the making of research results available for the scientific educational campaign of the Society.—McM.

Society Proceedings

Membership in a society devoted to your specialty is an essential to success.

INTERSTATE ASSOCIATION OF ANESTHETISTS.—FIFTH ANNUAL MEETING.

The Interstate Association of Anesthetists held its Fifth Annual Meeting in Cincinnati, Ohio, at the Hotel Gibson, September 15-16, 1919.

After the address of welcome by Dr. C. T. Souther, of Cincinnati, Dr. E. I. McKesson presented the gavel to Dr. J. J. Buetter, of Syracuse, N. Y., chairman-elect, who then presided.

During the executive session the minutes of the previous meeting and the treasurer's report were accepted as read. The following officers and members of the executive committee were elected for the 1920 meeting:

W. I. Jones, D.D.S., Columbus, O., Chairman; Samuel Johnston, M.D., Toronto, Canada, Vice-Chairman; F. H. McMechan, M.D., Avon Lake, O., Secretary-Treasurer; A. S. McCormick, M.D., Akron; John H. Evans, M.D., Buffalo; Marie Kast, M.D., Indianapolis; A. E. Smith, D.D.S., Chicago; Ralph M. Waters, M.D., Sioux City, and Roy S. Hopkinson, D.D.S., Milwaukee.

The secretary-treasurer was voted an appropriation of $250 for his services during the past year. The place of meeting, as usual, for the 1920 meeting was left to the discretion of the officers and executive committee.

The following members were elected: Drs. Myra E. Babcock, Detroit; W. D. Braun, Buffalo; A. D. Caldwell, Platesmouth, Neb.; Cline M. Chipman, Washington, D. C.; Morris H. Clark, Kansas City; Rozelle M. Cope, London, O.; S. J. Coulter, Toledo, O.; F. E. Coultrap, Toledo, O.; P. L. Crume, Dayton, O.; J. C. G. Fitzhugh, McKeesport, Pa.; James A. Flanagan, Shenandoah, Pa.; T. L. Gregg, Dayton, O.; Frances E. Haines, Chicago; Walter H. Hartung, Toledo, O.; T. F. Higgins, Toledo, O.; W. J. Hodson, Dallas, Tex.; F. B. Jones, Cleveland; G. W. Kiel, Columbus, O.; C. LaRocque, Montreal; D. A. Leahy, Cincinnati; Al. J. Lewis, Dayton, O.; A. J. Marlewski, Cleveland; Anna W. Marquis, Norwich, N. Y.; R. C. Matteson, Sioux City, Ia.; John Morgan, Rochester, N. Y.; H. C. Neale, Pittsburgh; F. M. Ogden, Cincinnati; H. E. Packard, Sioux City, Ia.; E. A. Peebles, Wilmington, O.; J. G. Poe, Dallas, Tex.; C. E. Price, Toledo, O.; C. J. Reynolds, Buffalo, N. Y.; C. E. Richmond, Colorado Springs, Col.; S. D. Ruggles, Portsmouth, O.; K. I. Sanes, Pittsburgh; C. R. Singleton, Clarksburg, W. Va.; Edyth Smith, Cincinnati; F. J. Sullivan, Columbus, O.; Joseph S. Sullivan, Toledo, O.; R. W. Weaver, McKeesport, Pa., and C. W. Wilkinson, Sioux City, Ia.

During the scientific session the following papers were presented:

Reaction of the Tubercular to Ether Therapy, Ernst Zueblin, M.D., Cincinnati;

The Blood Picture in Experimental Ether Anesthesia, J. B. Rogers, M.D., Cincinnati;

Some Results from Anesthesia Experiments on Animals, W. I. Jones, D.D.S., and Clayton McPeek, M.D., Columbus, O.;

The Third Stage of Ether—A Subclassification, Arthur E. Guedel, M.D., Indianapolis;

Selective Anesthesia, Morris H. Clark, M.D., Kansas City, Mo.;

Draw-Over Ether Vapor Anesthesia; Its Advantages and Apparatus for Use, Ben Morgan, M.D., Chicago;

General Anesthetics for Intraoral Operations, C. H. Burmeister, D.D.S., Cincinnati;

Nitrous Oxide-Oxygen Anesthesia for Oral Surgery and Dentistry, J. P. Henahan, D.D.S., Cleveland;

Somnoform, a Neglected Anesthetic for Oral Surgery, Oel E. Lanphear, D.D.S., Kalamazoo, Mich.;

Possibilities and Limitations of Local Anesthesia for Oral Surgery, Bion R. East, D.D.S., Detroit;

Postoperative Lung Complications with Special Reference to Oral Procedures, Isabella C. Herb, M.D., Chicago;

The Advantages of General Over Local Anesthesia in Tonsillectomy, Harvey M. Becker, M.D., Sunbury, Pa.;

Can Anesthesia Be Made a Specialty?, Cline N. Chipman, M.D., Washington, D. C.;

What Can Be Accomplished by Local Organization?, A. W. Hartung, M.D., Toledo, O.;

The Question of Fees and Advertising, C. C. McLean, M.D., Dayton, O.;

The Legal Status of the Non-Medical Anesthetist, Mr. Lewis, Counsel N. Y. State Medical Society.

The Interstate was accorded a Joint Session by the American Association of Obstetricians and Gynecologists. During this session the following papers were presented and discussed:

Safety Factors in the Team-Work of Operator and Anesthetist, John J. Buettner, M.D., Syracuse, N. Y.;

Surgical Barrage, Chas. W. Moots, M.D., and E. I. McKesson, M.D., Toledo, O.;

Nitrous Oxide-Oxygen Anesthesia in Labor, Charles E. Turner, M.D., Columbus, O.;

Some Adjuncts Which Promote Efficiency in the Use of Local Anesthesia in Major Surgery, R. E. Farr, M.D., Minneapolis, Minn.;

Post-Operative Analgesia, Bertha Van Hoosen, M.D., Chicago.

The Annual Dinner was served by the Hotel Gibson in the Cascade Room on the first evening of the meeting. The visiting ladies were entertained at several theater parties.

Quarterly Index

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[American Journal of Anesthesia and Analgesia]

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April — 1920

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THE ADVANTAGES OF GENERAL OVER LOCAL ANESTHESIA IN TONSILLECTOMY.*

HARVEY MAYOR BECKER, M.D.,
SUNBURY, PENN.

In presenting this paper a two-fold purpose is intended. *First,* a discussion of its title as it stands, and *second,* a means of bringing into rhinological literature a fatal case of novocain anaphylaxis. Apologetically, I wish to say in advance that it is not intended to cover a search of the literature on allied subjects, but represents wholly my own observations and opinions, based upon twenty years hospital and private practice, including my own successes, failures and end results, as well as the postoperative results that I have seen, of numerous other surgeons, good, bad and indifferent.

There are many of us who cannot and will not argue the merits of local anesthesia, and many of us who cannot and will not argue the merits of general anesthesia. We fully understand each other so long as we agree. In this meeting both groups are well represented, and it is to be hoped that the subsequently expressed opinions will start a thorough, and benefitting discussion. The advantages and merits of the various anesthetics will not be considered, as it is not dependent upon the kind, but upon whether it is local or general, as to what may not be accomplished during the operation, and with the best results and greatest safety to the patient.

COMPARATIVE ADVANTAGES AND DISADVANTAGES.

The advantages of general over local anesthesia may be stated, viz.:

GENERAL.

1. *Hemorrhage, less.*
2. *Shock, mental, less.*
3. *Shock, surgical, less.*
4. *Faucial, complete removal.*
5. *Pharyngeal, complete removal.*
6. *Trauma, muscular, less.*
7. *Trauma, blood vessels and nerves, less.*
8. *Adherence of pillars, less.*
9. *Resulting scar tissue, less.*
10. *Safety of anesthetic, more.*

LOCAL.

1. *More.*
2. *More.*
3. *More.*
4. *More chances for incomplete.*
5. *Never complete.*
6. *Trauma, muscular, more.*
7. *More.*
8. *More.*
9. *More.*
10. *Less.*

In the discussion of these ten advantages, or disadvantages, I do not expect or hope to convert any one with set mind from one group to the other, but wish to be understood as presenting them with an open mind, to the open minds of my hearers. One of the most difficult things to unlearn and discontinue in any life endeavor, especially true in medical practice, is one that has met with our convenience, economy in time, labor and equipment but without consideration of the individual whose trust we receive and whose money we take. The use of local anesthesia will come within any one of the above reasons, but at the same time against any one of the ten advantages of general anesthesia as above stated. Many of you will gainsay this. Your argument is expected and solicited. Put all your power into it, not from the standpoint of your own convenience, as I, much to my disgust have heard, but from the basis of the greatest safety and benefit to your patient.

HEMORRHAGE.

1. Hemorrhage: Needless to say, annoying and severe bleeding does not occur in a proper, total, removal of a faucial tonsil, hemophilia excepted, but will certainly occur in the event of undue injury or cutting of mucous membrane, pillars, fossa or incomplete removal. This is so universally true that after the snare has passed behind the tonsil, as was expected, and bleeding persists more than a minute or two, it is my custom to search at once for a stump, and always find it, unless I know that I have erred in technic in the separation or application of the snare. Since the advent of aspirating apparatus, such as is available today, one need not hurry for fear that the patient will come out of the anesthetic, nor that the blood will flow into the trachea and lungs. I have an especial advantage from the fact that I have assembled the good parts of several aspirating devices, giving at the same time either warm or cold ether, under pressure gauged from zero to any desired amount; pure, or admixed with air or oxygen, or both; aspirating to any required amount of vacuum, and furnishing air, heated to any desired degree, flowing either from its natural tendency to rise above the cold, which is considerable in the presence of cold ether vapor, or driven by any amount of pressure up to fifty pounds, and certainly a valuable aid at times, to check an annoying oozing. The device is safe, being electrically heated in completely en-

*Read before the Section on Oral Surgery and Dentistry of the Interstate Association of Anesthetists, during the Fifth Annual Meeting, at Cincinnati, September 15-17, 1919.

closed case and remote from the patient. The ether heating device is hot water and safe, rather than an electric heating unit beneath the ether bottle, which unfortunately on several occasions within the knowledge of some of my hearers has proven itself a dangerous equipment. All these parts I have mounted into or upon one cabinet, under the absolute control of the anesthetist by a single foot switch. The ether bottles are available, one warm, one cold, controlled by a three-way cock. Two aspirating bottles of one gallon each connected in series, and with vacuum gauge permitting instant regulation in amount of suction, scarcely permit flooding by overflow even when doing a rather large number of operations. This of course depends upon the quantity of water required to keep the aspirators free and unobstructed. Under, and with such devices careful and gentle separation of pillars and plica is possible in most instances. There is no interference by edema, such as results from injecting local anesthetics, nor swallowing with consequent movement of pillars and tonsils, an empty act or with blood and mucus, no gagging, no desire or necessity to spit, no moving of patient from being, or fear of being hurt—in fact, the entire absence of annoyances so many times present by any other method than general anesthesia.

What seems to me one of the greatest incentives and advantages is, that what bleeding will occur is at the time of operating, and not secondary, two or three hours afterward, when the blood returns to the vessels from which it had been driven by the epinephrin in the local anesthetic, and in which vessels there is no clot to prevent a secondary flow. This unimpeded bleeding it appears to me, is a direct result of the interference with nature's method of control, namely, retraction and contraction of the vessels, holding the usually present fibrin in the blood, in quantum sufficiat to form a clot. The use of sufficient epinephrin to control bleeding, precludes the presence of blood for some time, and on its return finds the vessels standing open, not unlike broken water pipes, more or less fixed, and incapable of, or at least not showing any great tendency to retract or contract at their severed ends.

Avoiding reports in literature, with which you are all familiar, I beg to give my personal experience as being called to the hospital once in every two thousand general antsthesias, and once in every ten local anesthesia operations, because of a secondary hemorrhage requiring treatment. This proportion might have been greater by the use of common sense and good judgment about ten years ago. Upon the complete removal of a tonsil for a patient about twenty years of age, a large mass of apparently varicose veins was seen in the fossa on the right side. No bleeding was present at the conclusion of the operation and lacking good sense, I did not tie off the entire mass. Injury, separation from their connective tissue base on the tonsillar side, as well as the removal of support, permitted a large break in several vessels, apparently synchronously, and with an alarming hemorrhage. These figures apply to tonsil operations only with a total of nearly eight thousand.

I would not have you feel that I know, or think I know, how to use local anesthetics, because it is possible that I do not: and it is also possible that I do not know how to operate with or under local anesthesia. These are, however, my experiences, and you may feel assured from what has been said, and more from what follows, that I have discontinued tonsil surgery under local anesthesia.

Several years ago in a friendly discussion with a general surgeon of unquestioned repute, admired by the profession and the public, holding a lucrative state position, within the hearing of one of our members, now present, whom we honored at one time with the Presidency of the Pennsylvania State Society, unburdened himself somewhat in this manner, viz.: "Any man who anesthetises a child and in its helpless state entirely removes its tonsils, is a criminal and should be in jail. The hemorrhage from such operations is terrific." (?) (This may not be the exact word used.) He then continued, saying: "Dr. ———, after an operation of this kind sat all night by the bed-side holding a gauze sponge in the throat with his fingers, and in the morning said: 'Thank God, she lives'." My reply, before proceeding with this paper. "Any man who wraps a child into blankets, placing it into a restrained though struggling position, its body held by an assistant, the head by a nurse, and with the smear of weak cocain solution over the tonsils, proceeds to shave off the projecting part, leaving the buried part in situ, is a brute and ought to be shot before he can cripple more children." The surgeon quoted by him lives in a neighboring state; has been before us for a number of years for his unquestioned research work; was called into the general advisory board or council during the recent war; has been meritoriously honored by title and medals for his valued service, but his knowledge of the proper removal of tonsils, which results in such dangerous hemorrhage as well as to methods of control, must be very limited, or he would not sit by the bedside all night holding a sponge, facing death, but would proceed to control it. In the past

I have understood that he would teach you how to remove tonsils in a week. I do not feel that it is now compatible with his usual sound judgment, or within his province to advise against general anesthesia and complete removal. His opinion should be passed as having missed its mark in the "I'll set you right" attitude in which some of us have been pleased to place him.

MENTAL SHOCK.

2. Mental Shock: By this I mean the shock to the conscious mind of the child which is being held tightly in its roll of blanket, undoubtedly being hurt, perhaps more by seeing the approaching knife, or other aimless instrument, than by the shaving off of the projecting part of the tonsil. This mental injury is greater than the physical. Visible bleeding usually does not have a very sedative effect upon any child, especially if produced by one whom it knows as "Doctor." Neither of these will obtain under proper and humane methods.

Digressing, I beg your indulgence of one good example of such operative methods by a general surgeon. A boy about 6 years of age, had his tonsils "skinned off," while securely rolled into the blanket. Adenoids not molested. Following the crude proceedure, frequent sore throat occurred, and I have the information from his physician that it was not possible to see his throat for several years, and that upon request nervous symptoms became manifest that precluded insisting. At the age of 11 years, resulting complications from the bungling operation as well as its incompleteness, caused an acute suppurative ethmoiditis. (It may have been chronic with acute exacerbation.) An abscess pointed nearly at the alae of the nose, was incised and drained by his physician, and closed spontaneously after several days. At the same time edema of both lids, some redness of the globe, soon followed by proptosis of marked degree, loss of vision preceded by diplopia, insomnia, some stupor, in fact sufficient evidence to warrant immediate operation for ethmoidal disease. His fear of hospital, nigh unto a phobia, caused, in my opinion, sufficient delay to produce retrobulbar abscess with extention to, and involvement of, meninges, so that late operative interference was without avail, death resulting in less than 48 hours. At operation it was found that the previously incised abscess had its source in the anterior ethmoid cells. My argument is that with proper tonsil surgery the lad would be alive. You may say earlier ethmoid operation. I reply, he should not have had ethmoiditis. Some may argue that the fault lies with the operator, rather than with the anesthetic. This phase I hope to cover in its proper place. Operated under general anesthesia he would have permitted inspection of the throat and would not have had a hospital fear. I contend, therefore, that this lad is dead because he was so unfortunate as to meet a local anesthesia general surgeon.

SURGICAL SHOCK.

3. Surgical Shock: In my experience the shock under ether is probably greatest at the end of the first twenty-four hours. By the end of the second twenty-four hours the ether patient has practically recovered, and the local anesthesia patient is right in the midst, and that two or three times the length of time is required for recovery. It is further doubtful in my mind whether a child ever fully recovers, the severity of the surgical shock seemingly adding to, or producing a mental element, certainly not to be desired in your or my child. This, of course, does not occur in every case, for which let us be thankful, but one in a hundred is too many, especially when that one may be avoided.

COMPLETE REMOVAL.

4. Complete Removal of Faucial: This is a more difficult procedure than many men think, or of which they know and appreciate the value. The quiet, flexible and pliable throat lends itself to the most delicate manipulation, without interference with the required succeeding steps leading to complete removal, with a minimum of trauma. Not so, in my experience with an injected and edematous throat, more or less constantly kept in motion by even the most willing and best patient, constantly defeating the surgeon's utmost efforts and skill at what can be made a harmless manipulation of the remaining parts. Probably the greatest damage is done when the snare is passing through in a slow method, as usually if a slow method is used, it is at this time that the patient has a desire to gag or swallow, probably from traction on more remote structures, consequently moving either the throat musculature or his whole head or body, a movement impossible to follow, and necessarily causing stretching or tearing of muscle fibers that can and should be avoided.

One patient vomited with a snare drawn taught, with tearing of muscle fibers. The rapid snare removal certainly will tear tissue that had better not be torn, and undoubtedly predisposes to bleeding. The knife dissection, to which local anesthesia so nicely lends itself, I feel cannot be mentioned except to condemn, as it so frequently is followed by the adherence of the pillars. With the attending edema, moving muscles, and by this time slight, or even considerable bleeding, obscuring the field, min-

ute inspection for small remaining stumps becomes difficult and uncertain. The attempted use of an aspirator in local anesthesia work has not proven satisfactory to me. If swallowing could be prevented the annoying throwing back into the fossa of a well everted tonsil would not occur very frequently, possibly would be entirely prevented, but unfortunately it very frequently so happens that the patient thinks it a good opportunity to swallow while one reaches for the snare.

REMOVAL OF PHARYNGEAL TONSIL.

5. Complete Removal of Pharyngeal: This is comparatively easy if care is taken under general, but I wish to say that I have never seen a clean removal under local, either in my or the work of others. If you have any idea that complete removal is the rule, take my advice and never make an examination of the pharynx with the pharyngoscope unless you wish your conscience jarred. At times I thought a complete removal of the pharyngeal tonsil had been accomplished, but several weeks later an examination with the pharyngoscope sent something up my spinal column with a sensation of an icicle, well crowned at the top with a feeling akin to having taken money under false pretense. And this is not the end. How about the possible eye or ear complication? How about the resulting deformity of the septum, jaws and teeth? Have we put the boy beyond the line of rejection for future military service? I need not give the answer; you know it.

It appears there are surgeons who are especially fond of showing MOTHER the "Adenoid," and what she sees, usually, is a little, nearly round mass about the size of the end of her finger, with the remark: "My! Isn't that large," not having the least idea if it should be the size of the peach or only that of the contained seed. The surgeon with a faraway, knowing look, and with great eclat accompanied with a respectful bow replied, "Yes Madam," takes her money, lets her depart in good cheer with the idea and understanding that she has done her duty by having the much heard-of and more dreaded adenoids removed from her boy, and feeling that now he will not be handicapped by retarded and defective development, with slowed mentality, but in position to vie with his companion who had to have the harrowing experience of taking ether and remaining in the hospital for several days, just because the other surgeon was not well versed in the recent refinements of the throat specialist, and did not know how to do it. This is not an idle jest. We frequently receive these compliments from the inferior quality residing in a larger city.

We are content that we are free from guilt, and the only pleasure attached comes when the boy fails to progress, and we have the opportunity to thoroughly clean him and give him our best belated start, with less gold, but a good result and a clear conscience. School inspectors frequently report tonsillar disease, and are informed by the child or parent that they have a biased mentality as "the tonsils and adenoids were removed a year ago." A child suffering chronic eye disease directly resulting from tonsillar necrosis, said that the school inspector has told her she has diseased tonsils and that she "Had a notion to spit into his face as she had been operated upon over a year before." She had a good mutilation, but the offending, much decayed faucial remnants and all but two or three of the central lobes of the pharyngeal were present. Pressing the truth to her mother caused a burst of anger. The father, considered the leading dentist in his village, offered the statement, by way of mild rebuke, that his friend who did the operation is as good as anything we could show in our community. Not having made any comment concerning the surgeon except result, there was no opportunity for reply, but we entertained the pleasant thought, "let us hope." Her failure to recover from the eye disease, and the failure to convince the parents lost the patient. She now wears glasses and I have been informed that she has had her tonsils removed twice since that time, as they "always grow back again." All I can say is "Poor kid." This has all been local anesthetic work. You will say you have seen the same result under general, to which I agree, and further beg to say, to the everlasting disgrace of our specialty, that not half of the bungling is done by the general surgeon when he wanders outside his own sweet pastures, but by some of the never dim and brilliantly shining lights of the metropolis. New York's report of seven per cent. of clean work would substantiate this statement.

TONSILLECTOMY IN THE ARMY.

It seems to have been a sort of pleasant passtime to remove the tonsils of the "boys" in the army, especially at some of the cantonments. I understand that it was usually done under local anesthesia, that usually did not anesthetize. A few of the throats examined would indicate that something went wrong. Quite a large number of the operated men in my community have 'phoned my secretary during my illness and absence, and the opportunity of inspecting has been lost to me for

the time being. Something must be wrong or they would not ask to see me. People usually are not in the habit of consulting physicians with excess rates unless something hurts them. I have done several septal resections to remedy postoperative synechia, the result of the "Chief" sawing off a ridge or spur, traumatizing, in one case the inferior, and in the other the middle and inferior turbinates. Apparently the ridges had "Grown back again." The few throats I have seen are about on a par with this nasal surgery. If this signifies the Chief's work, what may we find from the subordinates?

One thing is already manifest. Many men who never removed tonsils before they went into the service, and while there spent their time with a lap-board, when they were not busy holding pus-pans, and carrying soiled dressing receptacles, are returning and diving into the specialties like a finished product. We may expect an outbreak of local anesthesia tonsil operations, much inferior to the usual standard, with the consequent and attending results. Business should improve for the man who can deliver the goods under such a stimulus, but at whose health and expense? I think it is our plain duty to deter these men until they have mastered the art. Give them all the opportunity and assistance possible. They are good men with good minds, otherwise they would not have been in the service of Uncle Sam. Rarely came the opportunity, in this war, for the man who did not operate at home with at least the average skill, to begin in the service. Other duties were found and imposed, returning him well filled with useful knowledge, and probably writing the most legible hand within his life. They have seen much and learned much, and with adaptability will learn rapidly to skillfully do those things in which they will now fail if permitted, in common parlence, "To go off half cocked," forever shattering what might have been built into an enviable reputation. We should advise and remind them to qualify in shooting before they go out to the range to capture the prize. Seemingly it is clear that for the elevation of the standard of the profession, and especially the specialties, as well as for the protection of an unknowing people, the guidance with an ever uplifting hand becomes our duty.

TRAUMA.

6. Less Muscular Trauma: This is sufficiently covered for the scope of this paper under No. 4, except that I should like to suggest that if we are going to operate, let us attempt to cause the least destruction to the parts involved, consistent with complete removal of the offender.

7. Less Trauma to Vessels and Nerves: The element of time possible for cautious and gentle procedure, in a quiescent and not edematous throat, enables one to throw back, or over, and out of danger, the teminating branches of vessels and nerves, evert the tonsil, and snare it without making traction causing tearing of either, a something rarely possible under a local anesthetic and with a conscious patient. If the operations could be done by both methods, and the end results compared, local anesthesia would be placed upon the bargain counter, by those who operate for the welfare of the patient, rather than for his money. Plethoric patients court bleeding their bodies, but not their purses. The advantages of general anesthesia would soon become known, and the advocates of local anesthesia would be forced into line or take the risk of an emaciated purse.

It is rather difficult to compare or draw conclusions from the inspection of different patients, as rarely two throats are alike, or the postoperative appearances similar. Several good examples have been available in my practice. An attempted local removal had to be abandoned after one tonsil was apparently completely removed. Later ether was given for removal of the other, and I regret that the abandonment did not become necessary sooner. On critical inspection two buck-shot sized remnants were found, having been concealed by the edematous pillar. Further discussion naturally falls under the next heading—

ADHESIONS AND SCARS.

8. Less Adhesions of Pillars, and 9, Less Resulting Scar Tissue: I have never made an attempt to operate on a child under a local anesthetic. This, for several reasons. I could never bring myself to believe that any child would hold sufficiently quiet to perform a minimum traumatizing operation, even with perfect anesthesia, or fool enough to hold for complete adenoid removal, not considering the danger of such instrumentation, with a moving head, as may be necessary behind and above the soft palate, and before I "roll the blanket" I cease operating. Not having children from which to draw conclusions, except those I have seen who had been operated upon by some other surgeon, I shall be as lenient as possible in my comment, fearing to appear in the light of a critic, in a matter in which I have not engaged and have unsoiled hands. It has been my good fortune to reoperate on two or three dozen children from one charitable home, who had had local anesthetic operations previously

and none of whom had any one of the three major tonsils removed. Numerous other children, most of them done at large city hospitals did not present, as a class of postoperative throats, any material difference. An excessive amount of scar tissue, in the fossæ and without, pale, thin, scarred muscles, sometimes the anterior pillars, but more commonly the posterior, and not infrequently both cut with a large percentage with adherence between the pillars. Postoperative aching throat was a common symptom, evidently resulting from pressure upon the entangled teminal nerve filiments.

With adults, wherein I also have unclean hands, the same symptoms and appearances are present, but to more marked degree; in many cases of others as well as mine the scar is very large. This is why I previously said that I am sorry forced abandonment under local did not arrive sooner. Without apparent difference in the tonsil removed under local and that under general, the postoperative difference is most marked, certainly not the best result to be had for the patient, nothing about which to be proud. Possibly greater mutilations are seen as having been accomplished under general anesthesia. One cannot conceive how any patient would be held for some of the mutilations I have seen.

As an example, young lad, 17 years, half of soft palate, entire uvula gone; over one inch of one anterior pillar lost, and adjacent posterior pillar cross sected, the resulting contracting scar almost completely closing the pharynx, necessitating mouth breathing, and to the further shame of the operator, half the tonsil on this side, and the entire on the opposite remaining. Another by the same "picture-book" general surgeon, all pillars cut with resulting sagging larynx below the sternal notch. These caused two sleepless nights for the "hatchet and saw" carpenter owing to profuse hemorrhage, which could be expected. My understanding is that he collected his full fee, five dollars each, and made no additional charge for remaining at the house all night. The size of the fee indicates the amount invested in preparation. Results like these cannot be attributed to the shortcomings of an anesthetic, but directly to the mutilator.

SAFETY.

10. Safety of the Anesthetic: For many years I have had within easy reach in my office, a 38 calibre pistol for which I have the greatest amount of respect as to efficiency, reliability, harmlessness and compliance to my will. It remains entirely harmless in its fixed position, and in the hands of a man competent in the handling of such a weapon. When recklessly handled, or by an incompetent who will point it in your direction and pull the trigger, causing your immediate death, and then advises your dependents that he "did not know it was loaded," it becomes a mighty power for destruction. A pistol never killed any one of its own accord.

I have a similar feeling of respect for ether. I do not believe it ever killed anyone of its own accord, but that it was always destructive because the man handling it made it so; not the gun; not the ether, but the man behind it. My feeling of security has always been vested in the ether, and if any doubts were entertained, they pointed to the anesthetist. When the anesthetist goes to the movies, or takes a trip to the Jersey coast during an administration to a patient, and as on one occasion in my experience I suddenly said, "What's the matter, the patient is not breathing," I received the reply: "By George, that's so," ether becomes dangerous. It might become very convenient to say, in the event of death, that it was caused by the ether, yet the ether was only an unwilling accessory to an incompetent and unreliable gunner.

Though numerous drugs used for local anesthesia are supposed to be free from danger, and though administered by my own hand, I am not able to feel that they are wholly safe at all times. They might be unsafe from their own toxic or anaphylactic reactions, or by reason of error in their preparation or administration. It is possibly not beyond the memory of some of you, and you may recall, an incident, an error, an unexpected reaction or result, whereby some patient took the silent route. I am able to remember a friend and well known physician, one whom I always held in the highest esteem, and with whom I had spent many pleasant hours in my University days, who most unexpectedly took the silent leave by the route of a druggist's error. My feeling is that he should be attending this session of our society, had a general anesthetic been selected for his tonsillectomy.

DEATH UNDER LOCAL.

This brings me to the second reason for presenting this humble paper—the death of a friend and patient under a local anesthetic. Just two years ago Mary S. ——, 27 years, and Elfreda S. ——, 25 years, sisters, brunette and blond, respectively, came to the hospital together for the removal of pathological tonsils. Both in good health except moderate chronic hypertrophic rhinitis and beginning ear complications, manifested by tinnitus, and slight reduction of hearing. Elfreda had also moderate intestinal toxemia with manifest exacerbations several times a year. Partly submerged

and necrotic tonsils were present in both, differing principally as to size, rather than condition. The choice of the anesthetic was left to me, and knowing both as fearless and most pliable and confident patients, I selected a freshly made sterile solution, half of one per cent. novocain, as it was at that time called, to which fresh, 1 to 1,000 adrenalin chlorid was added, ten drops to the ounce. For some unexplained reason, Mary was first called. Three drams of the half of one per cent. novocain solution was poured out of the sterile, glass stopper bottle into a sterile cup. About two and a half drams were injected around the tonsils, both superficially and one deeply behind the tonsil, according to my usual custom; the points of injection being selected in accord with the location and course of the nerve supply. Without incident a clean and painless enucleation was accomplished, unattended by either operative or postoperative hemorrhage. No toxic symptoms were present during or after operation. The entire procedure consumed about 15 minutes. She was returned to her room and Elfreda brought by the returning nurse. All tight clothing had been removed. An entire change of sterile linen, instruments, gowns, etc., was made. Into another sterile cup was poured two drams of the novocain solution, from the same bottle. No change had been made in the solution, and the possibility of its having become infected cannot be conceived, it being handled by a sterile nurse who had not removed it from its sterile towel wrapper, nor had the bottle been touched by her except with sterile towel covering her hand. About 100 minims were injected in the same manner and at approximately similar points as at previous anesthetizing of her sister, she, during the time laughing and joking, as was her custom, and absolutely without fear. I mention this fact because it has been suggested by numerous men that the psychic effect may be greater than the toxic, and contributing cause, as well as an added factor in unexpected and toxic reactions. Be this as it may, in about three minutes after the last injection and before any operative procedure was or could be begun, a slight convulsive movement involving only head and neck was noticed, followed in a few seconds by a more severe and extensive, including shoulders and possibly chest and upper arms. These were almost immediately followed by more violent attacks, so that the fifth or sixth resembled in its general character the violent leaping of a frog, with resulting overturned chairs and stools. Tightly holding her about the waist I succeeded in putting her on her back on the floor, from which a nurse and I at once found ourselves lifted, and were not able to prevent a violent head bumping. Tightly closed jaws, some frothing at the mouth, slight biting of the tongue, dilated pupils, fixed globes, wide palpebral fissures, excessive lacrymal flow, stertorous breathing, moderate, but soon marked, cyanosis, passing of the violent convulsive, seizures into a marked and general tremor, with occasional jerking of one or the other foot, flexion of the forearm on the arm, legs not flexed on thighs, thumbs tightly pressed into the palms, simulated somewhat an epileptic seizure. Cardiac action not materially abnormal, except in rate, reaching in several minutes 120. Respiration ceased in several minutes, preceded by prolonged expiration, and with a regular but rapidly decreasing volume of air. Two most excellent internists were called and responded immediately. Artificial respiration had been begun immediately upon the cessation of respiratory effort, with oxygen, atropin, rectal dilation and infusion, heat, posture, in fact all, within the combined knowledge of the two consultants, five nurses and myself, was done. All these efforts were fruitless, as we did not succeed in establishing a single voluntary respiratory movement. Complete paralysis of the respiratory center evidently having occurred. Respiration ceased in not more than ten minutes from the beginning of the convulsions, and to me it seems curious that the heart could be distinctly heard for three hours, and by gradual reduction became inaudible at the end of another half hour.

My knowledge and experience in this line is limited to this one fatality, for which I am duly thankful. To be a specialist in this branch of life-saving, does not constitute one of my desires. In a limited way, mostly by requesting from many of the large medical journals, any article bearing upon such fatalities, I have succeeded in finding five previously reported deaths, four in American and one in Italian journals, and have gathered the additional information of another at the Mayo Clinic, which I understand has never appeared in the printed clinic, issued by them. Through a shell-shocked, returned, Russian surgeon, I have the information that in Petrograd alone, one hundred and fifteen fatalities resulted in three weeks, during his service there in the Russian army, from the use of novocain, a German product imported through Sweden. From the quantity imported, distributed, and used at many points distant from Petrograd, from which reports were not obtainable at the time of his discharge from the army and return to America, he thinks that probably thousands of lives were sacrificed before, the more than

likely, intended toxicity was discovered. Two reasons for not believing that I had an intended toxic product are that I purchased the novocain in compressed tablets, ten in a vial; the fifth caused this fatality, and the solution of the same tablet injected in twice the quantity, did not cause symptoms in the sister of the patient but fifteen minutes before this death. In my ignorance I can think of anaphylaxis only, as a possible and probable answer.

Aside from the better quality of the work, the greater assurance that something has been done for the growing child that will enable him to keep pace with the more fortunate, and the adult with the symptoms and fixed evidences of chronic sepsis, not cured, but repaired and put into the best possible "running condition," with the least resulting contraction and deformity from scar tissue, and one such fatality to remember, when I know that this girl should be alive and in her place as her gray-haired mother's constant companion, is sufficient to make me think only of ether, reliable, faithful and safe, with a reliable and well trained man behind the gun.

SELECTIVE ANESTHESIA.*

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The recent improvement in the mechanical factor has greatly facilitated a more accurate study of the action and effects of our various anesthetic agents.

At present we can deliver to the patient a drug or drugs of known standard chemical composition and quality in a definite concentration, at a definite rate either singly or in combination. This fact enables us to make our observation on a more scientific basis than was heretofore possible.

The personal equation still remains the unknown quantity and a closer study of body reaction to our available anesthetics is desirable. The anesthetist should be acquainted with the general physical condition of his patient, know for what he is to be operated and the probably severity of that operation, and select for that particular patient the anesthetic or anesthetics which will not only assure a satisfactory condition during the operation, but will restore that patient afterwards, as far as the anesthetic is concerned, to a condition as near normal as possible, as soon as possible. Therefore to obtain the best results, the anesthetist must not be merely a *technician, but a keen diagnostician and prognostician as well.*

*Read before the Section on Physio-Pathology of the Interstate Association of Anesthetists, during the Fifth Annual Meeting, at Cincinnati, September 15-17, 1919.

DIFFICULTIES IN SELECTIVE ANESTHESIA.

Unfortunately we cannot always select for the patient the anesthetic which will do body tissues the least harm. This is so mainly because of mechanical reasons and inability to deliver sufficient concentration of gases, or to obtain proper relaxation where the lack of relaxation counterbalances the evil effects of the anesthetic used. The main factors to be taken into consideration in selecting the anesthetic to be used are:

1. General condition of the patient.
2. The nature and location of the operation.
3. The operator.

For convenience the first may be divided into several groups:

A. The healthy patient who comes for operation for some condition not effecting his general health, i. e., hernias, varicoceles, etc.

B. The toxic patient.

C. The shocked patient.

D. Patients with impairment of vital organs, i. e., kidneys, heart, blood vessels and lungs.

GROUP A.

A very large number of our patients will fall under Group A. These patients take most any anesthetic equally well without any evident permanent harm provided they are not over-dosed or over-shocked at the time of operation, yet personal comfort is important in these cases and must be taken into consideration in selecting their anesthetic.

In about ninety per cent. of healthy patients gas-oxygen is the anesthetic of choice, while in ten per cent., ether is the anesthetic of necessity. No other anesthetic in our armoir has the wide range of application with the same degree of immediate safety, producing ideal operative conditions in all classes of cases and operations as does ether. Yet because of its irritating effect on body tissues and detrimental after-effects, it is undesirable in the majority of cases. Cotton or ethyl ether which undoubtedly gives a greater degree of analgesia and less narcosis, avoids much of the toxic factor and bids fair to make ether the anesthetic of choice in more cases of this group. Through the courtesy of Dr. Cotton I have been able to use this ether in quite a few cases and find it most satisfactory.

Chloroform falls before the weight of popular opinion and after some unpleasant personal experience I can say that its use is not justified except when other anesthetics are not available. Ethyl-chlorid which is strongly upheld by Ware (American Journal of Surgery, Vol. XXXIV, No. 71) who estimates its mortality at about one to eight thousand, has been recently given popularity during the

war. It is well taken by this group of patients in short operations leaving no unpleasant or detrimental effects.

Obstetrical cases may be included in this group of patients. They are particularly well adapted to nitrous oxid and oxygen by the fact that you have to deal with a series of intermittant physiological pains, caused by muscular contraction, which pain must be relieved without interfering with their cause. In one hundred closely observed cases, I marked only 4 per cent. unsatisfactory. This was caused mostly by the patient being nervous and not allowing the mask to be properly applied. The mother mortality was nil while the baby mortality was 1 per cent., which was due to the unusually hard labor and high applications of forcups. There was no increase in infant cyanosis, in fact the color was better than normal as straight oxygen was given before the cord was tied. Infant jaundice which occurs under chloroform deliveries in from 25 to 30 per cent. was reduced to about 12 per cent.

GROUP B.

Quite a number of our patients fall for this large but neglected group. These are the patients who are either running on their alkaline reserve (compensated acidosis) or those who have used up that reserve and are unable to neutralize the acids produced, causing symptoms which may range from a foul breath to coma. Stanley Reimann estimates this class comprises fifteen or twenty per cent. of the patients showing insufficient alkali.

Every case of uncompensated acidosis is a potential shock case. To add any general anesthetic to the already acid-burdened body is to further invite shock and distressing post-operative conditions. These are the patients who go into shock easily, have a stormy recovery from their anesthetic and who may die several days later with the blame on the operation and not on the anesthetic. Old prostatic cases, severe infections, intestinal obstructions and eclamptics are usually found in this group. Chloroform is emphatically contraindicated. Ether as is shown by Reimann (American Journal of Surgery, Vol. XXXIII, No. 7, July, 1919) also Morriss (Journal of American Medical Association, Vol. LXVII, No. 19) produces a marked acidosis when given for any length of time at an ether tension sufficient to produce surgical anesthesia. Nitrous oxid also produces an increase in the body acid but not to the same degree. Local anesthesia is here the anesthetic of choice when possible. Or when used in combination with nitrous oxid preceded by morphin and atrophin.

GROUP C.

Group three, or shock cases, are frequently met with and cause no little anxiety. They are the cases that come to the operating table with shock or go into shock during the operation. Whether the cause of shock is nerve exhaustion, dilated splanchnic vessels, fat embolism, or acapnia, the symptoms are all the same and may be reproduced by deep etherization. Nowhere is it so necessary for the anesthetist to exercise such watchfulness and careful judgment as in this group. The best treatment for shock is prevention of shock or early recognition of shock and the anesthetist is in the best position to detect it in its incipiency and warn the operator of approaching danger. Cases in shock or those we suspect will go into shock, should always have a prophylatic dose of morphin and atrophin. Personally I make it a routine in all operative cases, except in nose and throat, children and very old people to give from one-eighth to one-fourth grain of morphin with one-hundredth to a hundred and fiftieth grain of atrophin or scopolamin. It minimizes the preoperative psychic disturbance, lessens or eliminates the excitement period of induction, prevents further nerve exhaustion and decreases the amount of general anesthetic necessary. Crile, in his extensive work, has proven the value of prophylaxis against shock, and where possible the technic of nerve blocking, and gas-oxygen anesthesia should be used. In these cases ether may be used to advantage in combination with the gas-oxygen in small stimulative doses. Spinal anesthesia, while it blocks sensory impulses, causes a lowering of blood pressure and defeats the purpose for which it is given in this group of cases.

GROUP D.

Patients with impaired vital organs must be handled with extreme care. Valvular heart lesions do not cause great anxiety if there is a compensation, unless there is unusually severe strain placed upon them during the operation. These patients general are running on their cardiac reserve force and any procedure which causes undue cardiac strain will produce undesirable results. The best index to cardiac risk is the patient's ability to stand physical exertion. (Willius, American Journal of Surgery, Vol. XXII, No. 10, Oct., 1918). Of the valvular lesions mitral stenosis is probably the most dangerous and any anesthetic to these patients is a grave risk. In the past year I have anesthetized four patients with very marked mitral stenosis. One of these, a short curretage, died twenty-four hours later from cardiac exhaustion and two others had a very stormy recovery and long convalescence. Needless to say these patients should be given the anesthetic which will produce a smooth induction and relieve all possible cardiac strain.

Patient with impaired kidney function should not be given ether or chloroform. Grondal estimates that there is a transient albuminuria in about thirty per cent. of operative cases under ether. Carl R. Ruddell (American Journal of Surgery, Vol. XXXV) makes about the same estimate. To just what extent these changes are permanent is not exactly known, but we do know that a kidney damaged and working at full capacity is not benefited by any agent which will cause a healthy kidney to show marked evidence of irritation. Local anesthesia or gas, therefore would be the anesthetic of choice. Spinal anesthesia is also well taken by these cases, provided, it is below the waist and is not accompanied by a high grade arterio-sclerosis or myocarditis. Where a general anesthetic is necessary gas-oxygen should be used.

Operative patients with respiratory diseases always cause us more or less worry. Our main object should be to avoid any further irritation.

During anesthesia further irritation may occur in two ways, either by the anesthetic itself or mucous secretions, or vomitus inhaled during the period when the patients natural reflexts are unable to exclude irritating material. This complication I saw arise frequently in France where the wounded soldier had also been gassed. Ether and chloroform were the only two ansthetics available. Chloroform being the less irritative of the two, was selected, but even then many fatal postoperative broncho-pneumonias occurred.

The acute pulmonary cases are most to be avoided. The chronics do not usually suffer much from short ether anesthesia. However, there is always danger of lighting up old processes that are at the time lying dormant. These patients should always have a preoperative dose of morphin and atrophin followed by a gas-oxygen anesthesia. Rectal anesthesia may also be used to good advantage as its elimination through the lung is not of sufficient concentration to cause serious irritation.

SECOND—THE NATURE AND LOCATION OF THE OPERATION.

The nature and location of the operation frequently relieves us of the responsibility of making a choice of the anesthetic that the patient shall be given.

Nitrous oxid is excluded in many cases because of the inability to obtain proper relaxation, inability to apply an air tight face or nose mask. The first condition is usually found in alcoholics, or heavy muscular men when the operation is high up in the abdomen. Here again liberal doses of morphin and scopolamin greatly facilitate matters. The second include operations about the face and mouth which interfere with the approximation of mask to face. Tonsil operations can be successfully done under gas if the operator is fast and no serious hemorrhage occurs. However the shortness of these operations as a rule do not detain the patient under ether long enough to produce any permanent damage and postoperative nausea and vomiting are the only ill effects experienced. So that in the majority of these cases ether is the anesthetic of choice. In any gas-oxygen anesthesia, the face or at least the ears of the patient should be exposed to view. In cases in which it is necessary to cover the face entirely with sterile drapings, ether should be given by intrapharyngeal, intratracheal, or open drip with the anesthetometer as this allows the anesthetist to remain away from the sterile field with less danger to the patient. Rectal anesthesia is applied here successfully, especially, in goiter cases or resection of glands about the neck.

THIRD—THE OPERATOR.

Last but not least the surgeon must be considered in selecting the anesthetic for the patient, his technic, his skill, his regard for the safety and comfort of his patient, must be known and acted on accordingly. As a rule, the surgeon realizes that the anesthetist is in the best position to know which mode of anesthesia is best for the patient, and to know just what condition that patient is in during the operation. It is a regretable fact, however, that there are still some surgeons who either for the sake of financial gain or personal conveniences will jeopardize the life and comfort of the patient intrusted to them, by using nurses or untrained physicians, thus bringing discredit upon their own profession by avoidable bad results.

The surgeon who wastes time by unnecessary conversation at the operating table, who tugs and pulls unnecessarily on abdominal vicera, and large nerve trunks, who handles all tissues roughly, disregards the anesthetist's warning of approaching danger, will always have bad post-operative results no matter what anesthetic is used. Cooperation is the keynote of success for the surgeon, as well as for the anesthetist. If by success we mean the safety and comfort of the patient. In the past ten years, both surgeon and anesthetist have begun to realize this more and more, with the result that team work has become a great feature in lowering operative mortality, and as any patient will tell you, who was operated on before that time, in adding to the personal comfort of the patient.

1222 RIALTO BLDG.

RESULTS OF ETHER ANESTHESIA ON SUSPECTED AND MANIFEST CASES OF PULMONARY TUBERCULOSIS*.

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The present title of my talk may appear rather out of date, since we all remember that any general anesthesia applied to a tuberculous individual may mean a dangerous procedure which though necessary in the performance of operations does not eliminate certain risks of reactivation of old, more or less dormant foci of tuberculous disease. So I must ask for your attention in bringing the discussion again upon the advisability and contraindications of ether anesthesia.

We all are acquainted with the almost miraculous results of a laparotomy in tuberculous peritonitis where the simple opening of the abdominal cavity, the short exposure of the abdominal organs to the air is followed by regress of the pathological symptoms. Many colleagues have been asking for the explanation for such a change, various explanations have been given, one of them being that the ether anesthesia must be responsible for the good results. Practical experimentation has led the originator of the closed cone ether method or as we may call it "the Savage treatment"[1] to the belief that ether anesthesia is a therapeutic if not a curative agent for tuberculous peritonitis, pleurisy with effusion and for more or less incipient cases of pulmonary tuberculosis.

Such claims necessarily demanded a closer investigation which was carried out at our institution and the results have already been published[2]. Since then, more data were secured which are partly contained in the present review, partly in the experimental work of our faithful colleague, Dr. J. B. Rogers, in charge of the Percy Shields Research Laboratory connected with our institution.

QUESTIONS TO BE ANSWERED.

In the study of tuberculosis particularily the pulmonary form we may answer the following questions:

1. Is there any improvement in the clinical symptoms?

2. Is there any change in the extent and intensity of the morbid pathological process?

3. Are there any dangers to be anticipated from the administration of ether in tuberculous patients?

4. Which are the effects of ether upon the function of different organs and the composition of certain body fluids, including the blood?

5. What is the action of ether and other similar products upon the tubercle bacillus?

6. Practical hints about anesthesia applied to cases of incipient or advanced closed or open cases of tuberculosis.

IMPROVEMENT OF CLINICAL SYMPTOMS.

As expressed in Dr. Savage's communications an improvement of appetite, of cough and expectoration, a change can be noticed. In our opinion this improvement is only temporary, lasting from a few days to perhaps a week. A gain in weight may be noticed in favorable instances, but need not be the rule. In advanced cases the improvement is hardly noticed or is absent and with increased temperature supervening in our impression a greater outspread of the disease must be anticipated. We must observe great caution in deciding whether or not incipient cases of pulmonary tuberculosis improve because they were given ether at one time or whether other beneficial factors were at work to lead to an arrest of symptoms and signs, suggestive of the disease. In my personal opinion, and supported by a careful study of our case histories, I am convinced that in a great percentage of cases the onset of active signs of tuberculosis are closely related to a tonsillectomy, appendectomy or even a lesser intervention suggested by the surgical confrère.

PATHOLOGICAL CASES.

The second question dealing with ether anesthesia producing a *change in the extent and intensity of the tuberculous lesion* we are justified by our pathological specimens and postmortem studies to answer negatively. Diffuse peritonitis, milliary tubercles scattered over the peritoneal lining of the abdominal organs, milliary fresh tubercles in the form of single tubercles, or in form of caseating tuberculous lobar and bronchopneumonic foci point very strongly towards a more extensive dissemination, which may easily occur during the stage of complete relaxation so favoring the aspiration of infective material into formerly healthy areas. Such findings are suggested by the hectic type of temperature, the more extensive signs of pulmonary involvement noticeable by physical examination. Animal experiments would emphasize such a possibility of greater susceptibility of pulmonary parenchyma towards tubercular infection and a greater possibility towards necrosis. Petroffs[3] experiments on Guinea pigs infected with experi-

*Read before the Section on Physio-Pathology of the Interstate Association of Anesthetists, during the Fifth Annual Meeting, at Cincinnati, September 15-17, 1919.

mental tuberculosis and subjected to ether treatment have revealed no therapeutic influence whatsoever, on the contrary a harmful and more destructive action by ether upon the pathological process is very plausible.

INCONVENIENCES AND DANGERS.

The third question deals with the inconveniences and dangers of general anesthesia or the subcutaneous introduction of ether. I would think the method of administration is of greater importance in determining to what extent a general anesthesia may become harmful to a case of incipient pulmonary tuberculosis, but the comparison of a carefully made physical examination before and after anesthesia will give the answer. Much discussion can be raised about the reliability of a physical chest examination depending so much upon the personal training of the doctor ordering or performing a surgical intervention, in the difficult recognition and interpretation of physical signs of pulmonary activity. In our daily experience we notice on cases sent to our institution from the outside what great disparity of opinion prevails in the recognition of chest findings, making a due allowance to these chest and lung lesions which are only tracked by stereoscopic lung pictures and which need not be associated with physical signs carefully looked for but not ellicited by the lung specialist. If it is only decent to expect, that before any general anesthesia is made, a careful chest examination has been performed, it is deplorable that operations are done on individuals without any examination of their chest organs being made. It is pathetic to see that shortly after even the operation of a rectal fistula, of hemmorhoids, that such cases are unable to recover and that the pulmonary tuberculosis started from the very moment of such surgical interventions and assuming a rapid fatal course within from three to six months. To cite special instances of this kind is not the purpose of this paper but from the many histories collected at our institution we can easily furnish such data. At this time I would like to bring before your eyes the warning sign of the railroad crossing, "STOP, LOOK, LISTEN!" and would add to it the important word REASON before embarking on a surgical intervention requiring a general anesthesia. The old recommendation of NIL NOCERE, still holds good and in the young generation of graduate doctors, untempered enthusiasm for the knife leads them to radical interventions, which, later based upon more ripened experience, would not meet general approval. Particularily deep anesthesia with the prolonged relaxation, the greater possibility of aspiration of tracheal and bronchial content into deeper portions of pulmonary parenchyma means a serious danger particularly for a manifest tuberculous case.

Aside from the greater extent of pulmonary manifestations clinically and physically noticeable, in my impression several fatal hemmorhages from the lungs seemed to be a factor worthy of consideration, as such complications need even not follow in close succession the anesthesia, but may be associated with the chemical and physical effects of ether upon the blood and cell plasma.

ETHER AND BODILY CHANGES.

We all are more or less familiar with the chemical and pharmacodynamic effects of ether upon the living body. It hardly seems justified to include a few remarks along that line. Investigations on the effect of ether upon metabolism have directed our attention towards the possible onset of acidosis during and after an ether anesthesia, and considering the changes resulting in the liver from the administration of chloroform (Davis and Whipple)[4], it would be desirable that similar studies would be made in the results of ether upon the parenchymatous and degenerative changes in the liver cells and other organs. Yamagava's[5] contributions establishing the lymphagogue effect of ether, resulting in a better drainage of the often clogged lymphchannels, this may constitute either a desirable or undesirable event. In a tuberculous individual it may favor the outspread and dissemination of infective material or toxic products and so must be looked upon as undesirable.

In our observations special attention was paid to the changes in the blood picture of ether cases treated for tuberculosis of the lungs. The total blood count, differential count and the study of the Arneth count suggested the facts that an initial rise in the total number of white cells is noticeable, with an increase in the lymphocytes, but such changes are of a short duration and with every successive etherization even by increasing the dose of the drug and the duration of the anesthesia, the response is less marked, finally subsiding altogether. Not only by such a procedure do we drain the natural means of resistance, but finally we hasten the decline in defence, permitting a more successful invasion of the tubercle bacillus. My friend, Dr. Rogers, as the next speaker on the program, will show in his work that the blood changes in animals become less and less pronounced by a repetition of the ether anesthesia. In giving these facts, we feel that we are yet unable to explain all the effects of ether upon the human organism, a great

deal more research work will be required. In this review only larger doses of ether were considered, whilst in the administration of smaller quantities the effects may be less injurious, we must believe the testimony of other investigators—Saliba[6], Hamburger[7]—that ether may in small doses have a bactericidal effect and a stimulating action upon the repair of injured tissue cells.

EFFECT OF ETHER ON THE TUBERCLE BACILLUS.

As regards the fifth question, the action of ether upon the tubercle bacillus investigations carried out by various authors[8] and myself[9], have lead to the possibility of a partial extraction of the fatty constitutents of the tubercle bacillus. It is not impossible that a more or less similar process takes place in a tuberculous focus. Experience has shown that these partial antigens are quite powerful and minute quantities injected subcutaneously are suffifocal reaction. It appears undesirable that in a general anesthesia we have no measure at all to dose these evidently toxic substances and the undesirable after effects of anesthesia may be partly linked to the liberation of an unmeasured amount of similar toxins. This point in my opinion deserves our attention and constitutes one element of objection for undiscriminate application of ether in a tuberculous individual.

Finally before closing my paper on the subject, it may seem that in enumerating the dangers and inconveniences of ether application in this class of patients designed as suspect and manifest cases of pulmonary tuberculosis, I would discard the use of ether entirely. I am well aware that there are certain cases in which we cannot get along without the use of ether. On the other hand, however, I would urge that no ether nor chloroform[10] anesthesia be given without any proceeding reliable chest examination being made and that if ever possible the anesthesia be cut short as much as possible. The administration of an anesthetic has developed into such an art, that I am sure that the specialist will adopt a clever method of removing and lessening pain without adding an undesirable injury to the patient's existence by allowing a dormant tuberculous focus to become active again so undermining the results of a skillful surgeon. Internal Medicine, the Art of Anesthesia and Surgery can and must work together in harmony and realize that great aim of our profession to prevent disease, erradicate suffering and preserve the sublime gift of human health and happiness.

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THE EFFECT OF ETHER ANESTHESIA AND SUBCUTANEOUS INJECTIONS OF ETHER ON THE CIRCULATING LEUCOCYTES.*

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Even in the considerable work that has been done to determine the effect of ether on the circulating leucocytes, the results obtained by different workers are not uniform. The majority of them have estimated the leucocytes before and after surgical procedures and it is difficult to draw the line between the effect of the operation and the anesthetic.

Chadborne estimated the number of white cells before and after the operations in twenty patients that had some degree of leucocytosis, and found an average increase of 37 per cent.

Cabot, Blake and Hubbard studied fifty patients before and after operation, 86 per cent. of whom showed an increase and 14 per cent. a decrease.

Ewing states that ether anesthesia will usually increase the leucocytes about 2,000. In an experimental study of three rabbits, he found no difference in the leucocytes before and after full anesthesia.

Da Costa and Kalteyer, in a study of fifty cases before and after operation, using ether anesthesia, found an average increase of 4,856 cells.

Frasier and Halloway made a study of forty cases suffering from malignant tumors (inflammatory cases, also non-inflammatory) and in each case found a marked increase, the minimum being 9,000 and the maximum 20,000 cells.

The difficulty of arriving at a conclusion of the results of ether anesthesia before and after operation is very apparent. In such conditions not only the injuries to the tissues, but loss of blood, evacuation of pus cavities and vasomotor influences and so on may be entirely responsible for any change in the cell variation before and after anesthesia.

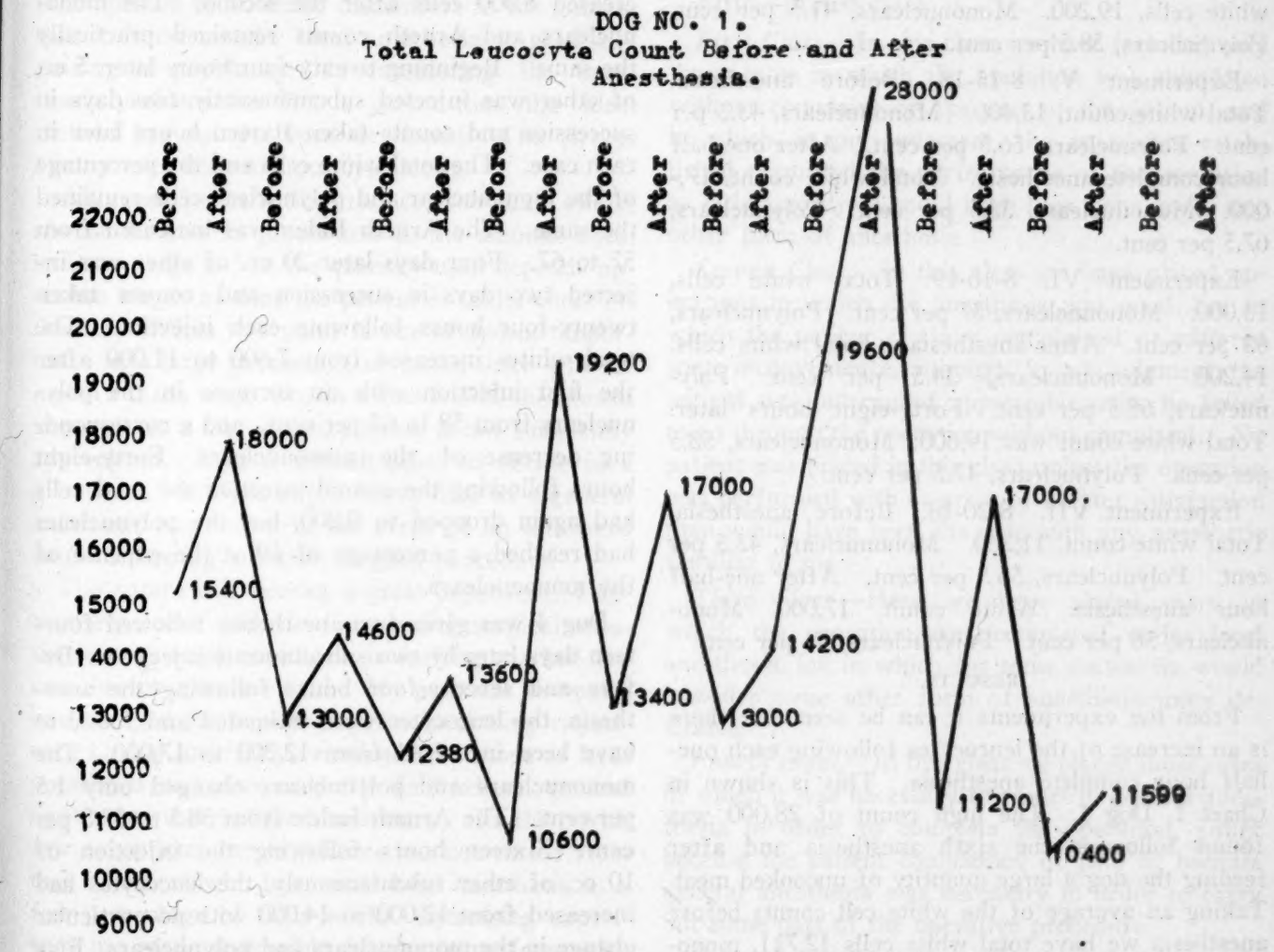
*Read before the Section on Physio-Pathology of the Interstate Association of Anesthetists, during the Fifth Annual Meeting, at Cincinnati, September 15-17, 1919. From the Percy Shields Laboratory, Cincinnati; Tuberculosis Sanatarium, University of Cincinnati.

PERSONAL STUDIES IN LEUCOCYTOSIS.

Having for several years been interested in the leucocytes both in health and diseased conditions, we are now extending the work on to investigations relative to the leucocytic changes brought about by chemicals, experimental infections, bacterial toxins, and non-bacterial protogenous substances. Our attention was directed to the employment of ether by Dr. Zueblin at the Cincinnati Tuberculosis Sanatorium, who used it as a therapeutic measure. This present paper is in itself only the experimental stage of the work. Those who practice in the field of Hemotology are familiar with the many factors that greatly influence the blood changes both in the individual and the animal, also numerous technical factors. To be brief, uniform results are hard to obtain with our present system of counting.

The work herein reported consists of fifty-three complete white cell and differential counts, forty-five of which were made on five dogs and eight on four rabbits. The Arneth nuclear classification was carried out on dogs 2, 3, and 4. This classification consists of separating the polymorphonuclear cells into five different classes according to the number of fragments composing the nucleus. The index is obtained by adding all of classes one and two and one-half of class three.

The normal index is 55 to 60; in bacterial infections and intoxication it may reach 90 to 95. We have found this index to correspond closely to the total white cell or polynuclear increase. The slides being fixed in alcohol and stained with hemotoxylin and eosin are suitable for both differential and Arneth counts.



EXPERIMENTAL RESULTS.

Experiment I, Dog I. 8-5-18. Leucocyte count before ether anesthesia 15,400. Mononuclears 44.5 per cent. Polynuclear 55.5 per cent. One-half hour after anesthesia, leucocytes 18,000. Mononuclears 48 per cent. Polynuclears 52 per cent.

Experiment II. 8-6-18. Before ether. Total white count, 13,000. Mononuclears 38.5 per cent. Polynuclears, 61.5 per cent. After one-half hour

anesthesia. Total white cells, 14,600. Mononuclears, 37 per cent. Polynuclears, 63 per cent.

Experiment III. 8-7-18. Before ether. Total white count, 12,380. Mononuclears, 46.5 per cent. Polynuclears, 53.5 per cent. After one-half hour anesthesia. Total white cells, 13,600. Mononuclears, 53.5 per cent. Polynuclears, 46.5 per cent.

Experiment IV. 8-8-18. Total white cells, 10,600. Mononuclears, 32 per cent. Polynuclears, 68 per cent. After one-half hour anesthesia. Total white cells, 19,200. Mononuclears, 41.5 per cent. Polynuclears, 58.5 per cent.

Experiment V. 8-15-18. Before anesthesia. Total white count, 13,400. Mononuclears, 43.5 per cent. Polynuclears, 56.5 per cent. After one-half hour complete anesthesia. Total white count, 17,000. Mononuclears, 32.5 per cent. Polynuclears, 67.5 per cent.

Experiment VI. 8-16-19. Total white cells, 13,000. Mononuclears, 37 per cent. Polynuclears, 63 per cent. After anesthesia. Total white cells, 14,200. Mononuclears, 34.5 per cent. Polynuclears, 65.5 per cent. Forty-eight hours later. Total white count was 19,600. Mononuclears, 52.5 per cent. Polynuclears, 47.5 per cent.

Experiment VII. 8-20-18. Before anesthesia. Total white count, 11,200. Mononuclears, 43.5 per cent. Polynuclears, 56.5 per cent. After one-half hour anesthesia. White count, 17,000. Mononuclears, 56 per cent. Polynuclears, 44 per cent.

RESULTS.

From the experiments it can be seen that there is an increase of the leucocytes following each one-half hour complete anesthesia. This is shown in Chart I, Dog I. The high count of 28,000 was found following the sixth anesthesia and after feeding the dog a large quantity of uncooked meat. Taking an average of the white cell counts before anesthesia we have total white cells 12,711, mononuclears 38.8 per cent. and polynuclears 61.2 per cent. One-half hour after, an average of 16,085 white cells, mononuclears 40 and polynuclears 60 per cent.

Dog 2. Two complete anesthesias were given, the first being followed in twenty-four hours by the second and counts taken five hours after each anesthetic. The total white cells were increased from 15,000 to 16,400 each time. The percentage of the mono and polynuclears showed a difference of only 1 per cent., which can easily be a technical error. Sixteen hours after the last anesthesia, the total white count had risen to 17,600 and the polynuclears had increased 7 per cent. with a corresponding decrease in the mononuclears. Two days after the last anesthesia, 5 cc. of ether was injected each day subcutaneously for three successive days and counts taken each day show the following white counts, 16,800, 15.500 and 16,000 respectively. The polynuclears, mononuclears and Arneth counts remained practically the same.

Dog 3 was given two complete anesthesias on successive days. The total white cells increased from 9,000 to 11,400 after the first anesthesia and decreased 8,000 cells after the second. The mononuclears and Arneth counts remained practically the same. Beginning twenty-four hours later, 5 cc. of ether was injected subcutaneously two days in succession and counts taken sixteen hours later in each case. The total white cells and the percentage of the mononuclear and polynuclear cells remained the same. The Arneth Index was increased from 57 to 67. Four days later 20 cc. of ether was injected two days in succession and counts taken twenty-four hours following each injection. The total whites increased from 7,600 to 11,000 after the first injection with an increase in the polynuclears from 58 to 63 per cent., and a corresponding decrease of the mononuclears. Forty-eight hours following the second injection the total cells had again dropped to 9,200, but the polynuclears had reached a percentage of 69 at the expense of the mononuclears.

Dog 4 was given two anesthetics followed fourteen days later by two subcutaneous injections. Before and seventy-four hours following the anesthesia, the leucocytes were estimated and found to have been increased from 12,200 to 17,000. The mononuclears and polynuclears changed only 1.5 per cent. The Arneth Index from 58.5 to 69.5 per cent. Sixteen hours following the injection of 10 cc. of ether subcutaneously, the leucocytes had increased from 12,000 to 14,000 with no particular change in the mononuclears and polynuclears. Five cc. was then injected subcutaneously and the leucocytes estimated twenty-four, forty-eight and sixty-two hours later, showing total counts of 13,000, 14,600 and 15,000 respectively, with no particular change in the differential count.

Four full-grown rabbits were given complete ether anesthesia and the total white cells and differential counts made just before and one-half hour after anesthesia. The average counts obtained were as follows: Before. Total white cells, 11,875. Mononuclears, 46 per cent., and polynuclears, 54 per cent. After anesthesia. Total white cells, 11,750. Mononuclears, 37 per cent., and polynuclears, 53 per cent.

SOME ADJUNCTS WHICH PROMOTE EFFICIENCY IN THE USE OF LOCAL ANESTHESIA IN MAJOR SURGERY.*

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MINNEAPOLIS, MINN.

Notwithstanding the boon that the discovery of general anesthesia has been to surgery, chloroform, ether, and gas have so many shortcomings and dangers, both immediate and remote, and their use is accompanied by so much discomfort to the patient, that it is no wonder local anesthesia is gradually gaining in popularity. In considering the anesthesia problem the fact is patent that the ideal method has not yet been developed. The virtues of any anesthetic are purely relative.

All general anesthetics produce their toxic effects almost directly in proportion to the amount used, and to a large extent the quantity used depends upon the length of time the patient is under their influence. While this point is not of special importance in a large percentage of cases, there still remains a fairly large class in which it is of the utmost importance, a fact which, I think is not sufficiently appreciated. It is a difficult point to decide in a given case just what part a heavy dose of a general anesthetic has played in the event of an untoward result following a major surgical procedure.

The future will develop a great improvement upon the present method of producing surgical anesthesia, and local anesthesia is making marked encroachment upon the field. My personal viewpoint has changed from year to year, increasing experience having invariably *broadened* the scope of local anesthesia and *decreased* the field where general anesthesia was believed necessary. In this, with few exceptions, my experience has not varied from that of others who have used local anesthesia in a fair percentage of their work. Increasing experience has made it possible for me to perform with satisfaction operations which I formerly believed to belong solely in the field of general anesthesia. Little difficulties have gradually been overcome by methods devised to meet them, with the result that I have been compelled repeatedly to modify my attitude on this subject.

FACTORS IN THE SCOPE OF LOCAL ANESTHESIA.

It is with a discussion of the possible scope of local anesthesia and some of the methods which facilitate its use that this paper will concern itself.

The scope of local anesthesia will depend largely upon the surgeon's attitude, which in turn is a fair index of his ability to use the method. The personal equation enters so largely into a consideration of the problem that one can give only his own experience and impressions.

We have arranged our cases into the five following classes:

First—Ideal.
Second—Satisfactory.
Third—Unsatisfactory.
Fourth—Failures.
Fifth—Mixed cases.

First Class.—In this class we have included only those cases in which the operation was completed without complaint on the part of the patient, and in which, in my judgment, the anesthesia established permitted the performance of the operation as satisfactorily as could have been done under any other form of anesthesia.

Second Class.—In this class we have placed operations in which the anesthesia was good, but in which the patient at times complained or suffered some inconvenience, although, in my judgment, the patient was not caused appreciable pain, he failed to go through the operation without complaint. No patient was placed in this class unless the operation was performed with as great or greater satisfaction than would have been the case with any anesthetic familiar to me.

Third Class.—Here we have placed cases in which the operation was completed under local anesthesia, but in which for some reason we would consider some other form of anesthesia more desirable.

Fourth Class.—In this class we placed those cases in which it was necessary to resort to general anesthesia in order to complete the operation, either because the patient complained of pain or because general anesthesia was necessary in order to carry out some part of the operative procedure.

Fifth Class.—In this class we placed the cases in which the use of general anesthesia had been anticipated or planned and only a certain portion of the operation was to be carried out under local anesthesia.

The record of the last six hundred major operations which I have performed serves as a fair index of my attitude at present regarding the scope of local anesthesia.

REPORT OF LAST SIX HUNDRED CASES.

		Per Cent.
Number begun under general anesthesia	49	.817
Number begun under local anesthesia	551	.919

*Read during the Fifth Annual Meeting of the Interstate Association of Anesthetists, before a Joint Session with the American Association of Obstetricians and Gynecologists, at Cincinnati, September 15-17, 1919.

Cases falling in Class One (Ideal).	383	.695
Cases falling in Class Two (Satisfactory)	114	.208
Cases falling in Class Three (Unsatisfactory)	36	.065
Cases falling in Class Four (Failures)	7	.012
Cases falling in Class Five (Mixed anesthesia)	11	

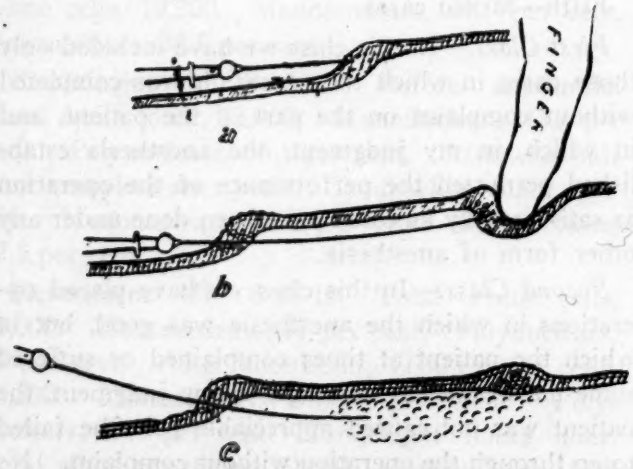


Fig. 1—Sectional views of the skin; *a*, method of making first dermal wheal; *b*, painless subcutaneous method of making secondary wheals; *c*, method of making subdermal infiltration.

FACTORS THAT HAVE INFLUENCED THE PERSONAL USE OF LOCAL ANESTHESIA.

Elements which have largely influenced me in the adoption of the present attitude may be enumerated as follows: *First*, a realization that liberal amounts of novocain can be used if properly safeguarded: *Second*, the development of an improved armamentarium: *Third*, the development of a morale on the part of my assistants and the hospital attaches which, together with the gradual education of my clientele, greatly influenced the mental attitude of prospective patients; and *Fourth*, an improvement in the method of handling the tissues.

At the present time all of our operations are begun under local anesthesia with the exception of cases in which it would be obviously impossible to handle the condition by this method. As may be seen by the above table, this amounts to approximately seven per cent. and is confined largely to work about the face and mouth in children and to adults who refuse the method.

VALUE OF COMPLETE AND DISADVANTAGES OF INCOMPLETE LOCAL ANESTHESIA.

While local anesthesia has many shortcomings, because certain operative procedures cannot be carried out under its use and certain patients will not submit to it, it is my belief that faulty technic is responsible for the vast majority of failures. Take, for example, a simple laparotomy for the removal of the appendix and shortening of the round ligaments, a perfect local anesthesia will allow us to complete this operation without touching the viscera within the pelvis except where it is necessary to attack the round ligaments and cecum. No gauze is necessary for packing off intestines and all pelvic viscera may be examined as at autopsy. On the other hand, an incomplete local anesthesia on the same kind of a case will give an entirely different picture. The patient who is repeatedly hurt during the injection, or perhaps has an incomplete infiltration, leaving sensitive areas in the field of operation, will develop in the abdominal wall reflexes over which he has no control, and which will cause the forcible extrusion of the intestines through the wound as soon as the incision is made. In order to retain the intestines within the abdominal cavity in such a case pressure by gauze pads is necessary. This in turn produces more pain which increases the combative action on the part of the abdominal muscles. We have here a *vicious circle*, which spells failure for the method in practically every case. The individual who blames local anesthesia

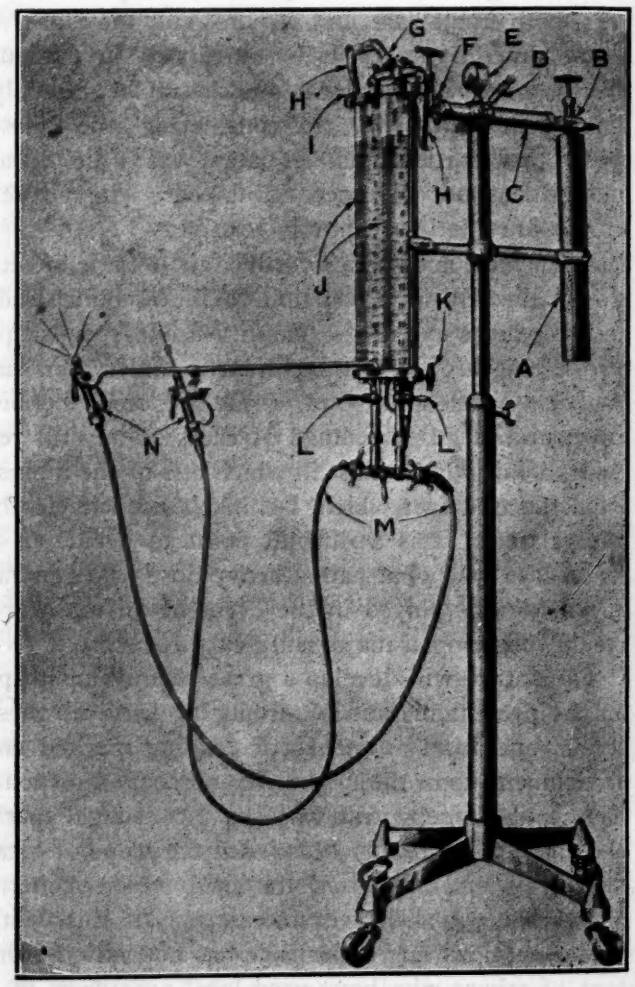


Fig. 2—Pneumatic Injector for use in introducing local anesthesia.

or the mental attitude of the patient for this condition can only be classified in one category by those who know what the actual cause of the trouble is, and yet this is what one usually sees when attempts are made to perform laparotomies by this method.

The ideal sought is a complete abolition of the reflexes of the abdominal wall, with its resultant relaxation, and a negative intra-abdominal pressure like that seen at autopsy. This is accomplished by a perfect anesthetization of the line of incision, painlessly produced, and gentle vertical retraction

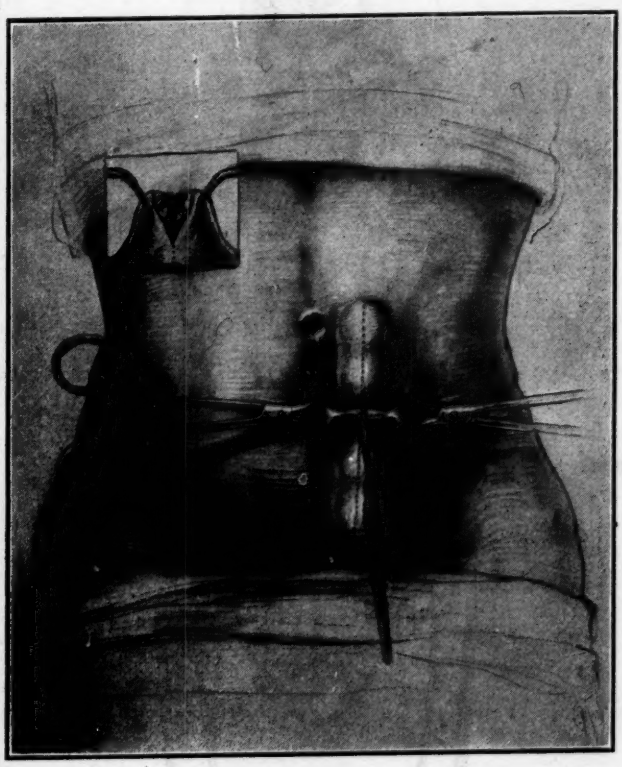


Fig. 3—Towel clips elevating the skin while incision is being made. Insert-end view of same.

of the abdominal wall. Exposure of the viscera is facilitated by the use of gravity. The Trendelenburg position and lateral tilting, etc.

POINTS IN TECHNIC.

To my mind the most important point is the careful introduction of the drug, and it is in attention to small details that success is achieved. All of the modern textbooks or articles on local anesthesia advocate the introduction of the needle at two or more sensitive points on the abdominal wall. This entirely unnecessary procedure is apt to upset the patient at the very beginning and to shake his confidence which may not be any too great at best. On the other hand, if the patient is only hurt once, as in making the first dermal wheal, and the future sites for the introduction of the needle are anesthetized from beneath (see Fig. 1), the anesthetic may be introduced almost without sensation. Syringes on account of their jerky action and the muscular effort required have been found unsatisfactory for smooth and perfect work. Even the improved syringe which eliminates the necessity of refilling does not give one the opportunity to carefully disseminate the solution into the tissues. The Pneumatic Injector, which we have used for ten years, gives one the greatest opportunity for smooth and painless infiltration of the tissues. (See Fig. 2.)

Once the anesthesia is established, the incision should be made with a sharp instrument, preferably between two towel clips which elevate the skin and prevent pressure upon the abdominal viscera. (See Fig. 3.)

During the making of the incision this elevation should be continued without intermission, and as soon as the peritioneum is opened, all abdominal viscera will drop away from the site of the incision, providing the anesthesia is perfect. (See

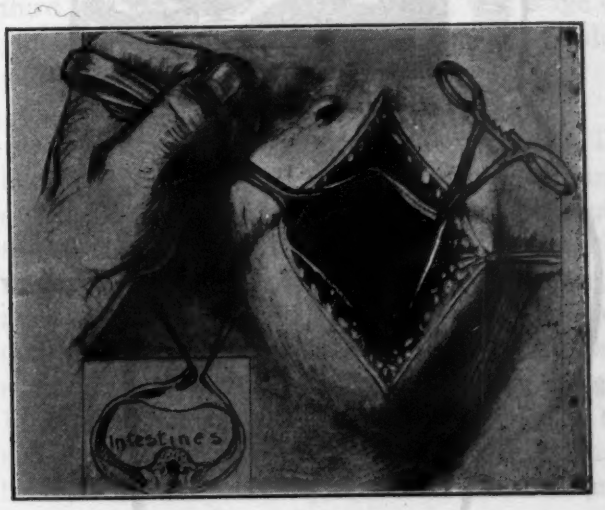


Fig. 4—Vertical retraction of the abdominal wall. Insert-end view of same.

Fig. 4.) A Trendelenburg position with lateral tilting will expose any organ in the lower abdomen In the upper abdomen the stomach, gall-bladder, duodenum, liver, and colon may be examined visually as well as digitally. The patient can, of his own volition, show the gall-bladder or stomach to the onlookers by an expulsive effort, and by opening the mouth and relaxing, can allow these organs once more to drop back into the abdomen. It is desirable to substitute suction for sponging. Abdominal packs are used only when there is danger of soiling, and then they are to be simply laid upon the viscera, and not forced snugly and with great pressure against serous-coated organs, as is so commonly done where the patient is under general anesthesia.

In all of our abdominal work, except in the operation for inguinal hernia, a direct infiltration of

the tissues is effected and the complete infiltration of the abdominal wall is made before the incision is begun. (See Fig. 5.) This method is chosen because of its efficiency, simplicity, accuracy, and speed. It is not used in the case of inguinal hernia because the infiltration of the tissues obscures to some extent the anatomical relations.

Visiting surgeons frequently inquire regarding the danger of introducing the needle directly through the abdominal wall and injuring the abdominal viscera. This danger is practically nil as

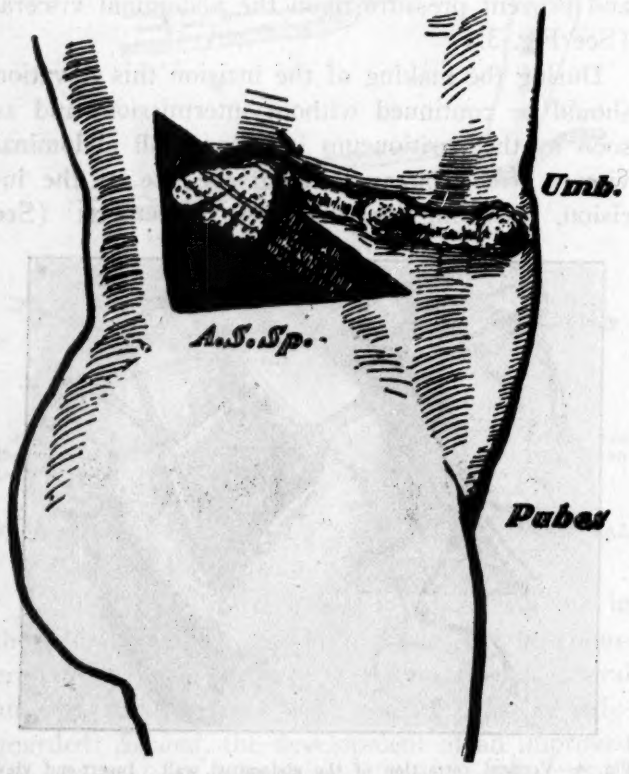


Fig. 5—Section of abdominal area infiltrated.

has been proven in thousands of instances in human as well as animal surgery. By advancing the needle slowly and constantly forcing a stream of the solution ahead of the needle point the peritoneum will seldom be penetrated. This point has been proven by using solutions colored with methylene blue.

Once the abdomen is open, vertical retraction, tilting, and careful handling of the tissues are our main strategic points. Sensitive visceral surfaces, such as are found in the round ligaments, the mesoappendix, about the uterine cervix, the ovarian pedicles, and the cystic duct of the gall-bladder may be anesthetized before being attacked. Long, fine needles, mounted upon the ball-and-socket joint of the cut-off as shown in figure 6, should be used where one wishes to make infiltrations deep within the abdomen and the hand does not obscure the view. Suction is substituted for sponging which may cause a disagreeable sensation.

Where traction on the pelvic viscera is anticipated, as in the case of bad infections or malignancy, caudal anesthesia precedes the infiltration of the abdominal wall.

Vicious, forcible retraction is to be condemned. In this work we employ the wire automatic retractor as shown in figure 7. The writer believes that visual examination of the abdominal organs is much more advantageous than digital. Extensive

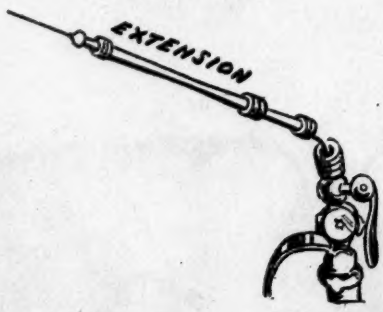


Fig. 6—Shows extension attached to cut-off for use in deep cavities.

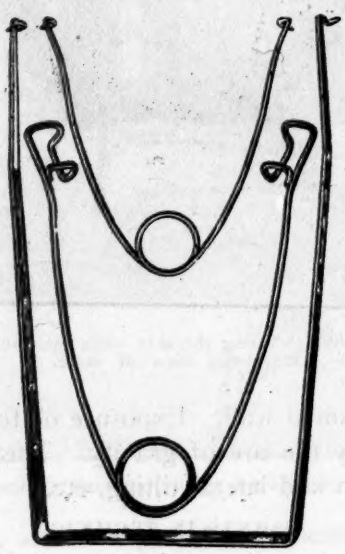


Fig. 7—Automatic wire retractors.

abdominal operations performed under local anesthesia, if done painlessly, usually show a patient with a pulse rate below 80, no sweating, normal respiration, normal color, normal temperature and an unchanged blood pressure at the end of the operation. The elimination of trauma to the abdominal wall and viscera insures almost without exception a smoother convalescence than we have been able to obtain under the use of general anesthesia. My experience leads me to believe that post-operative ileus and gas pains are, in the absence of infection, directly proportionate to the amount of trauma

employed during the operation. Nausea and thirst, and vomiting, with its disagreeableness and its sequels of wound strain and pain are largely eliminated.

LOCAL ANESTHESIA IN CHILDREN.

When operating upon children under local anesthesia restraint is necessary while the anesthetic is being introduced. Figure 8 shows a simple manner in which this restrain may be employed without

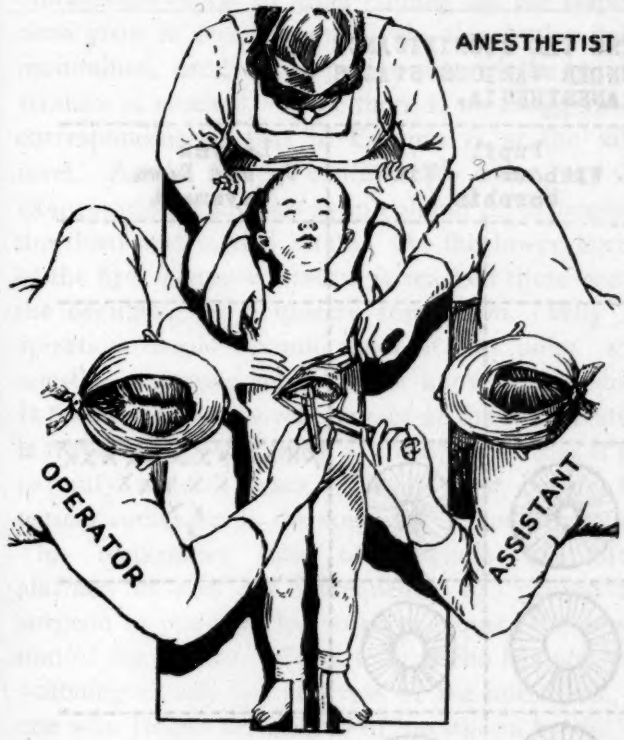


Fig. 8—Illustrating the method of controlling young children in operations under local anesthesia. By making traction on the arms the anesthetist controls the child when necessary.

in any way interfering with the technic of the operation. My experience of more than 100 operations performed on children under the age of fifteen shows that the restraint necessary is probably less than ten per cent. of that required during the administration of a general anesthetic and that this class of patients lend themselves exceptionally well to this form of anesthesia.

301 PHYSICIANS' AND SURGEONS' BLDG.

THE INTERSTATE ASSOCIATION OF ANESTHETISTS HAS BEEN ACCORDED THE DISTINCTION OF A JOINT MEETING WITH THE PENNSYLVANIA STATE MEDICAL SOCIETY, AT PITTSBURGH, OCTOBER 4-7. THE PROGRAM FOR THURSDAY AFTERNOON WILL BE DEVOTED TO PAPERS ON ANESTHESIA BEFORE A JOINT SESSION OF ALL THOSE IN ATTENDANCE. IT IS ALSO EXPECTED THAT THE NATIONAL ANESTHESIA RESEARCH SOCIETY WILL MEET AT THE SAME TIME AND PLACE. MAKE YOUR ARRANGEMENTS TO ATTEND. ALL THE ACTIVITIES OF THE MEETING WILL OCCUR IN THE WILLIAM PENN HOTEL.

THIRD STAGE ETHER ANESTHESIA: A SUB-CLASSIFICATION REGARDING THE SIGNIFICANCE OF THE POSITION AND MOVEMENTS OF THE EYEBALL.*

ARTHUR E. GUEDEL, M.D.,
INDIANAPOLIS, INDIANA.

This paper and the accompanying scheme of illustrations was used by the writer many times in teaching anesthesia with the A. E. F. in France.

The objects in presenting this paper are two: *First,* to encourage lighter and more even ether anesthesia; and *second,* to present some tangible form for didactic teaching of anesthesia to students.

Our literature up to date mentions four stages of anesthesia. The first stage, during which the patient experiences analgesia but does not lose consciousness; second, the stage of excitement; third, the surgical stage, and fourth, that stage beginning with cessation of respiration and ending with cardiac paralysis and death.

DEMANDS OF MODERN ANESTHESIA.

Modern anesthesia requires more than this. The knowledge that the patient is in the third or surgical stage is not now sufficient. We should be able to say at any time in just what part of the third stage we are carrying anesthesia. The latitude of third stage anesthesia with ether is great, so great that the patient may easily be given more ether than necessary without being in any immediate danger. Postoperative toxemia is in direct proportion to the amount of ether administered. The patient may be carried lightly with good relaxation and quietude, and suffer but slight postoperative toxemia from the ether, or he may be carried for an hour in the deepest part of the third stage with immediate safety so far as the anesthetic is concerned, but the postoperative toxemia will be great. Light anesthesia, if it be acceptable to the surgeon, is infinitely better than deep anesthesia. We have known this for a long time, but have not known that there is a very light stage of surgical anesthesia which affords the surgeon as much ease and comfort in operating as the state of deepest third stage anesthesia. We have often stumbled onto this stage,—one of quietude and tranquility, but were usually alarmed by the apparent respiratory depression, and by withdrawing all ether, have usually lost it.

Many of our anesthetists, even of today, state that it is necessary to watch only the respiration of the patient in order to determine the degree of

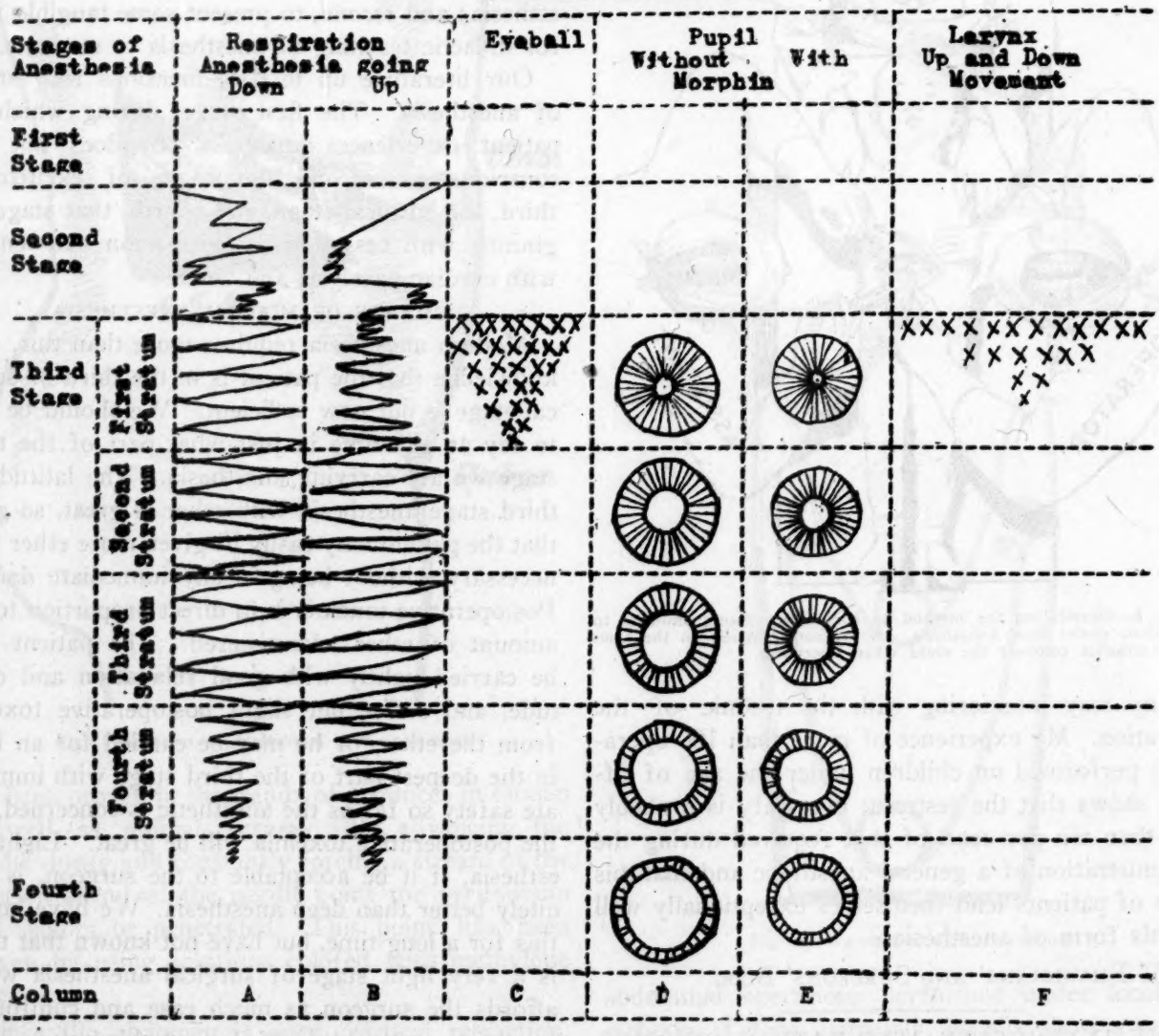
*Read before the Indianapolis Medical Society, April, 1919; the Indiana State Medical Association, at Indianapolis, September, 1919, and the Sixth Annual Meeting of the Interstate Association of Anesthetists, at Cincinnati, September 15-17, 1919.

anesthesia present. However, our better anesthetists realize that they must take note of every available sign in their work if they are to do it well.

VALUE OF EYEBALL AND PUPIL.

In my experience, which includes over 10,000 cases conducted personally and by my assistants in France, the eyeball with its position and movements has afforded a sign which, in proper classification, is reliable and cannot be ignored. The oscillation

SCHEMATIC CHART SHOWING THE SIGNIFICANCE OF CERTAIN REFLEXES UNDER VARIOUS STAGES OF ETHER ANESTHESIA.



marks the stage of ideal anesthesia after the first ten or fifteen minutes of administration has elapsed.

I have divided third stage ether anesthesia into four strata. The accompanying chart presents a correlation of the various signs found in the different strata of the third stage. Attention is called in this paper only to the third stage, inasmuch as there is nothing new to be said of the first, second and fourth stages. The chart consists of columns A, B, C, D, E and F, and takes into consideration various signs separately and in conjunction with each other.

COLUMN A—SHOWING RESPIRATION WITH ANESTHESIA GOING DOWN.

There is no regularity or rhythm to the respiration of the second, or stage of excitement. From experience we recognize the transition from the second to the third stage, by the inauguration of respiration that is rhythmical and exaggerated. The exaggeration is marked and continues so, almost without change, provided there is a continuance of sufficient ether to carry the anesthesia progressively downward throughout the first, second and third strata of the third stage. However, as the fourth or deepest stratum of this stage is entered, the respiration shows beginning depression. This depression continues progressively downward through

the fourth stratum until its complete cessation marks the transition into the fourth stage.

COLUMN B—RESPIRATION WITH ANESTHESIA COMING UP.

After respiration has ceased as the fourth stage is entered, the ether has been removed and respiration started by artificial means, it will begin as it left off, with shallow movements. As the patient unloads his excess of ether coming up, the respirations grow in depth progressively, the rhythm being maintained, until the upper border of the fourth stratum is reached. Here there is an exaggeration corresponding to that in Column A at the same level. As the patient continues to come out, this exaggeration continues as in column A, throughout the third and second strata. As the lower border of the first or upper stratum is reached there occurs the beginning of a quieter respiration. Why respiration should become quiet at this point with anesthesia coming up, I do not know; but it does. It becomes progressively quieter as the first stratum is traversed upward, until at the upper border it apparently almost ceases. This is just before the patient comes out to the coughing or vomiting state. This respiratory state of quietude has often alarmed us and not infrequently has caused the surgeon to pause in his work to inquire the condition of the patient. True, to one who has not been watching closely the progress of the anesthesia, to one who judges the degree of anesthesia by the respiration alone, the finding suddenly of this quiet respiratory stage is apt to be alarming. Under the old rule of "When in doubt, wait!" which by the way is always a good rule to follow, the ether would be removed and the patient soon found vomiting or becoming unquiet. However, there need be no doubt about the degree of anesthesia here. The question to be decided is a simple one. Is the patient just ready to come out, or to go out? In other words, is he in the first stratum of the third stage, or in the fourth stratum. The answer to this lies in the eyeball.

COLUMN C—THE EYEBALL: ITS MOVEMENT OR ITS POSITION.

The eyeball offers one of the most important signs in anesthesia today. *As long as the eyeball is oscillating or is in an eccentric position though stationary, there is no danger that too much ether has been given. Aside from extraneous circumstances, such as positional asphyxia, hemorrhage, or shock, if the eyeball is moving or is stationary but eccentric, the patient is safe and in good condition.*

As the patient enters the first or upper stratum of the third stage, either from above or below, there is manifest a partial paralysis of the motor occuli muscles. Either there will be an intermittent contraction and relaxation, or variations of these, causing a rhythmical oscillation of the eyeball, or there will be a stronger tonic contraction of one set than of another, resulting in a stationary but eccentric globe. Occasionally in the alcoholic, or the individual of high reflex nervous tension, in place of the above there will occur a peculiar slight twitch of the globe, usually in a lateral direction. This twitch may not occur until from three to five seconds after the lid has been raised for inspection, therefore this inspection should not be momentary. When this twitch does occur, whether late or early, it means the same thing as above, namely that there is only a partial and not a complete paralysis of the motor occuli muscles.

Whether there be a rhythmical oscillation, an eccentric stationary globe, or the twitch just mentioned, the meaning is the same: the patient has not had too much anesthetic and, other things being equal, is in an ideal stage of surgical anesthesia.

As seen in the accompanying chart, the motion or eccentricity of the eyeball is greatest at the extreme upper border of the first stratum of the third stage. As anesthesia progresses downward from here this motion or extreme position decreases progressively until the second stratum of the third stage is reached. The transition from the first to the second stratum is marked by the cessation of the eyeball movements, or by the change from *eccentric* stationary to *centric* stationary position of the globe. This is the point at which the paralysis of the motor occuli muscles becomes complete.

With anesthesia going down there is no further movement of the eyeball, no further contraction of any of the motor occuli muscles.

THE PROBLEM OF RAPID INDUCTION.

In hospital anesthesia as it is conducted today, with the hurry to have the patients ready for the waiting surgeon, they are forced under rapidly, either with straight ether or with the nitrous oxid, or ethyl chlorid, or some other ether sequence. They are usually taken to the knife before there has been time to "even them up," or before they have settled down to an even ether saturation. Consequently, at first, there is a deeper degree of anesthesia necessary for quiet relaxation than that indicated by the partial paralysis of the motor occuli muscles. Here it is up to the anesthetist to put the patient, in the beginning, down to the second or even the third stratum, as herein illustrated, but to

allow him to come up to the first stratum, that of the oscillating or eccentric eyeball, as soon as possible, *and to maintain him there.*

In this state the patient presents a better operative general condition than in the second or third stratum, because of the quiet respiration. As a rule it is as satisfactory to the surgeon as the fourth or deepest stratum.

In anesthesia with ether, carried for an hour or more, if the eyeball be *kept oscillating* the patient will usually emerge shortly from the anesthetic and there will be less nausea and depression than we have formerly experienced. By watching the eyeball reflex internes are now conducting better anesthesia than before.

If it were always possible to use as much time as one desired in the induction of ether anesthesia, the patient could, in the course of fifteen minutes or so, be carried gradually to this first stratum of the third stage and anesthesia be there maintained throughout the operation. But for some inexplicable reason, in most hospitals, the idea of saving time is to *start* the operation. Its finish may come when it will.

In finishing the consideration of Column C of the accompanying chart, it is important to say that when the respiration is found very quiet and seemingly depressed to a considerable degree, *the eye must be inspected.* If the eyeball is oscillating or eccentric the sage of anesthesia is right and ether should be continued. If the eyeball is *stationary on center* with the pupil dilated, the anesthesia is too deep, and ether should be discontinued at once.

COLUMN D—PUPIL WITHOUT MORPHIN.

Morphin is so universally used as a preanesthetic narcotic, either alone or in combination with other drugs, that this column is of only relative importance. Before the advent of the use of morphin generally for this work we were taught that the pupil may be dilated, but that it must react to light. *Without morphin the pupil, in the average case, does not begin its dilation until the lower part of the second or upper part of the third stratum is reached. Therefore the dilated pupil, even without morphin, is an indication of anesthesia being too deep.*

COLUMN E—PUPIL WITH MORPHIN.

The statement has often been made that when morphin is given in combination with atropin in the usual proportions of 1/4 and 1/150 gr., the pupillary reflex will be the same as when no morphin is given. This is not true. With this combination the pupil will not as a rule dilate as early in anesthesia as when no morphin has been given.

It is safe to assume that when morphin has been given, no matter in what combination, a dilation of the pupil in the conduct of anesthesia is a manifestation of careless technic on the part of the anesthetist.

NOTE: Columns D and E of this chart cannot be considered accurate for all cases. But though they may not be accurate, they are sufficient to show that in neither case is it necessary to have any dilatation of the pupil in order to secure quiet and relaxed anesthesia.

An apropos note is here in order. No anesthesia can be safely relaxed and quiet, no matter how much ether be given, if the respiratory passages be not kept freely open, or if the patient be suboxygenated. Where the respiratory passages cannot be kept constantly open, pure oxygen should be administered, whether through the ether or separately. Only thus in certain cases can the patient be relaxed.

COLUMN F—THE LARYNX; ITS MOVEMENTS.

Although an ancient sign, this movement of the larynx is not to be ignored, especialy in this classification. With the eyeball moving or eccentric the danger in conduct of the anesthesia is not that the patient may "Go out," but that he may "Come out." *There is usually at all times a rhythmical movement of the larynx up and down with the respiration. There is always the exaggerated movement of this organ up and down with swallowing. This is well manifest in the induction.*

This movement of the larynx in swallowing is of importance here in that it assists the anesthetist in guarding against vomiting during the operation. *With anesthesia coming up, at the extreme upper border of the first or upper stratum of the third stage, just before the patient comes out to the vomiting or second stage, there will occur, in the average case, an exaggerated up-and-down movement of the larynx, half a minute or so before vomiting takes place. If the little finger of the mask-holding hand be allowed to rest over the larynx, this exaggerated movement may be detected immediately it begins. There is yet time to increase the amount of ether gradually, sufficient to carry the patient back where he belongs without permitting retching or vomiting.* I say *gradually,* because if at this stage a concentrated ether vapor be suddenly administered, there will usually follow laryngeal, or pharyngeal spasm, with coughing.

THE REFLEXES UNDER OTHER ANESTHETICS.

Although this paper is intended primarily to cover the third stage of *ether anesthesia,* the significance of the eyeball in this classification is not limited to ether alone.

These signs hold good with any anesthetic agent now commonly in use, no matter what attention has been paid to preanesthetic narcotics. Morphin in any combination does not influence them. Neither does chloral or its allied drugs. *The eyeball signs are constant.*

NITROUS OXID-OXYGEN.—With this mixture alone, I have never been able to get a patient anesthetized beyond the stratum of the oscillating or eccentric eyeball where the anesthesia was properly conducted. Proper nitrous oxid-oxygen anesthesia requires a pink or rose-colored patient. As long as this color is maintained it is quite out of the ordinary, if not impossible, to carry the anesthesia beyond the first stratum as herein illustrated. In *improper* anesthesia with this agent, the asphyxial element being allowed to enter, it is, of course, quite possible to so intoxicate the patient with carbon dioxid that there will occur a complete paralysis of the motor occuli muscles and a complete dilatation of the pupil. This is inexcusable technic.

ETHYL CHLORID.—Properly handled, this agent is an excellent substitute for nitrous oxid and therefore deserves mention. There is much that is new in the way of observation of the action of this agent that cannot be considered here. Suffice it to say, that with ethyl chlorid, administered slowly, as long as there is maintained only a partial paralysis of the motor muscles of the eyeball, the anesthesia is entirely safe. Ethyl chlorid should not at any time be given beyond this point.

CONCLUSIONS.

1. This is a plea for lighter and better anesthesia.

2. It is a plea for better teaching of anesthesia in our medical schools and hospitals.

3. As long as we note any movement or eccentric position of the eyeball, aside from that which might be normal for the occasional patient, that patient has not had too much anesthetic; but after anesthesia has been well inaugurated, he has had quite enough.

4. The upper part of the third stage, namely, the first stratum, is anesthesia entirely as satisfactory to the surgeon as the second, third or fourth stratum of the third stage.

517 HUME MANSUR BLDG.

ANESTHESIA IN WAR SURGERY

NITROUS OXID ANESTHESIA.*

It would seem as though someone were trying to take away all the glories and thrills of an operation, when he introduces an anesthesia that eliminates the after-effects that are so characteristic of ether and chloroform, as well as increases by 20 per cent. the chances for recovery.

As an anesthetic for use in the United States Army, nitrous oxid was first suggested to the American Red Cross Commissioners, in France, by Colonel George W. Crile, M. C., U. S. A., who also made the suggestion that plant for its manufacture be erected there in order to insure a sufficient supply for all the army hospitals. To the efforts of Colonel Alexander Lambert, then Chief Surgeon of the American Red Cross, is largely due the plan that brought such highly successful results.

The best medical authorities concur in the opinion that nitrous oxid as an anesthetic is the least dangerous as

Fig. 1—Nitrous oxid generators in the American Red Cross Plant in Paris.

well as the best adapted for use when operating upon cases of shock. As compared with ether and chloroform, perhaps a review of the chemical effects of these upon the patient will serve to prove the superiority of nitrous oxid. Great muscular exertion or wounds of the muscles cause lactic acid to be disseminated through the blood in large quantities. The body rids itself of the acid by oxidizing it, and for the most part gives it off through the lungs. When chloroform and ether are introduced into the blood that is already filled with lactic acid, they stop the oxidizing process. This results in an acid condition which will in many cases cause death. The use of nitrous oxid with oxygen allows the natural oxidation to proceed uninterruptedly. To guote Colonel Lambert's tersity: "The use, therefore, of nitrous oxid anesthesia

* Supplied by the News Service of the American Red Cross. Courtesy of Mr. Foster, New York City Headquarters.

(*Continued on page 60.*)

American Journal of Surgery

QUARTERLY SUPPLEMENT *of* ANESTHESIA *and* ANALGESIA

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F. HOEFFER McMECHAN, A.M., M.D., *Editor*
Avon Lake, Ohio, U.S.A.

APRIL EDITORIALS. 1920

A NOTE ON NITROUS OXID-OXYGEN ANESTHESIA.

Reporting to the Southern Medical Association on his experiences with anesthesia in war surgery, Dr. Addison G. Brenizer, of Charlotte, N. C., formerly Lt.-Colonel, M. C., U. S. Army and Chief of Surgical Service, Base Hospital, No. 6, A. E. F., says that nitrous oxid-oxygen was used between September 10 and November 14, 1918, only and during that period of 65 days, anesthesias were given as follows:

Ether	473
Nitrous oxid-oxygen	341
Local	87
Chloroform	7
	908

Publishing his observations in the *Southern Medical Journal*, October, 1919, Brenizer explains that:

"Gas-oxygen anesthesia was used during that short period, not that we did not prefer it, but because we were late in receiving our apparatus and were not able to secure more gas when our first supply was exhausted.

We have used ether overwhelmingly over other anesthetics, quite a number of infiltration anesthesias with novocain and cocain and but little chloroform. We have rarely used ethyl chlorid as a general anesthetic, but have used it frequently for small incisions locally. There was but one death we could attribute to an anesthetic and that was a death from chloroform in unskilled hands.

The tranquility of the patient, the rapidity and ease of induction, the rapidity of recovery and the safety withal, gives nitrous oxid-oxygen quite an advantage over the other anesthetics in the first and second stages of anesthesia, especially in cases where an absolute muscular relaxation is not needed. Even when ether is superimposed for deeper anesthesia, the amount is reduced to a minimum to maintain the period of relaxation.

The types of cases where gas-oxygen is most valuable are:

1. Shock cases;
2. Cases where operation is to be of short duration;
3. Cases where the condition is profoundly bad and the post-operative period treacherous;
4. Chest cases, with the exception of those liable to show hemorrhage; and,
5. Infection of the respiratory tract.

Gas-oxygen is of great value in war surgery since the greater number of delayed primary and secondary suture of wounds can be made with the use of this anesthetic alone.

The special advantages of gas-oxygen in war surgery are:

1. Ease and rapidity of inducing anesthesia, thus preventing a struggle, enabling the immediate beginning of the preparation of the field of operation and the carrying on of several parallel operations without the one disturbing or distressing the other.
2. Rapid recovery and rapid exchange of patients between operating room and ward.
3. The relief from the care of recovering patients on the wards and the consequent liberation of the personnel for other duties.

All these points are important when the large number of secondary wound closures are considered—as many as 60 in a single day.

The comfort of the patient is a decided point.

There was no death nor injury from this anesthetic."

THE NATIONAL ANESTHESIA RESEARCH SOCIETY.

In a previous issue the Editor of the SUPPLEMENT called attention to the founding of the National Anesthesia Research Society.

The Editor is now able to give in detail the objects of this organization, which are:

1. To promote the science of anesthesia and to enable its members or others, after having obtained the approval of the society, to submit to the dental and medical professions any views, findings, or accomplishments they have attained.

2. To obtain from all available sources such information as is now extant concerning any material, liquid or gas, known to have anesthetic properties.

3. To arrange, in cooperation with medical, dental and anesthesia associations, for the preparation and delivery of suitable, interesting and educational papers on the general subject, or relative to some particular anesthetic.

4. To use its influence to prevent the publication or circulation of any false or unauthentic statements concerning the science or practice of anesthesia or about any anesthetic.

5. To receive and tabulate reports of any and all conditions, symptoms or phenomea prevailing during or after anesthesia by any anesthetic and to prepare and distribute on request forms on which such information can be tabulated with uniformity.

6. To distribute by pamphlet or publication, as its funds may permit and its governing powers authorize, such reliable data as may be collected or obtained from those interested in the subject.

7. To aid, as far as possible, in the preparation, publication and sale of suitable text books on the subject of anesthesia, for use by students in elementary and post-graduate schools, and to prepare as rapidly as possible and as far as its funds permit, reference books for use by the medical and dental professions.

8. To cooperate with the state authorities and other bodies in the preparation of suitable legislation to safeguard those to whom anesthetics are administered, as well as those called upon to administer them.

9. To arrange for the production of moving picture films to illustrate to the profession the action of anesthetics on the patient during the induction and maintenance of anesthesia, and to prepare interesting articles for publication in magazines and the public press.

10. To use its influence in every way and to give its aid toward the advancement of the science and practice of anesthesia.

There will be two classes of members in the Society, those representing the business interests that are financing the movement for bettering anesthesia and duly licensed and qualified practitioners of medicine and dentistry.

The government of the Society is vested in a Board of seven Governors, five of whom represent the business interests of the organization and two the professional.

The Governors will hold quarterly meetings during the year—in February, May, August and November, in which month the Annual Meeting of the Society will also be held.

The scientific work of the Society will be largely in the hands of a Research Committee of which the Editor of the Supplement has accepted the Chairmanship and Dr. W. I. Jones, of Columbus, O., the Secretaryship. This Research Committee is empowered to secure and utilize the services of research workers and noted clinicians to cooperate with the Society in effecting the purposes previously mentioned. Any expenditures for such services shall be made at the discretion of the Board of Governors.

The ulterior purpose behind this new Society is the achievement of an Anesthesia Foundation.

The Editor of the SUPPLEMENT bespeaks for the Society the cordial support and cooperation of all those who have the progress of anesthesia at heart. —Mc.M.

INTERESTING NEWS NOTES.

It will interest readers of the SUPPLEMENT to learn that the anesthetists of Boston have recently organized. Also that the Anesthesia Department of Harvard Medical School has been reorganized from the teaching, clinical and research standpoints, by Drs. Freeman Allen and F. L. Richardson.

There is also a movement under way to organize the medical and dental anesthetists of Philadelphia. Mr. Stephen Morris of the National Anesthesia Research Society and Dr. Theodore D. Castro are urging the matter.

Word comes from Cincinnati that Dr. John C. Oliver, Acting Dean of the University Medical School, is heading a movement to establish a Chair of Anesthesia in that Institution. If his plan eventuates it will be the first Chair in this subject to be established in any American Medical School.

Every effort is being made to have a worthwhile paper on anesthesia presented before every important medical and dental meeting during 1920. Your individual coöperation is requested in accomplishing this purpose. Do not hesitate to secure a place on the program of a meeting in your vicinity and use every effort to give those in attendance the most recent progress in your specialty with which you are familiar.

NITROUS OXID ANESTHESIA.

(*Continued from page 57.*)

to the exclusion of ether or chloroform in the case of at least the seriously wounded, seems to me not only advisable, but beyond the advisability of discussion."

Nitrous oxid was therefore first used at the casualty clearing stations, the Americans and British cooperating for the sake of an exchange of ideas as to its use. The American Red Cross supplied an apparatus of special design that had been worked out from those already in use. This apparatus allowed the separate administration of nitrous oxid, of oxygen, of ether (which was at times used in small quantities) or of the three in various combinations. As soon as was feasible, a meeting of surgeons was held in order to discuss the question of anesthesia and it was decided to use nitrous oxid to a much greater extent than had been done.

The beneficent aspects to surgery in the use of nitrous oxid as an anesthetic show the following advantages: no added shock to shock patients, no lowered vitality, less toxemia, less post-operative respiratory complications, speed, *i. e.*, quick return to consciousness, thus leaving the nurses free the sooner to give care to other patients. Its use has been found to be especially beneficent in cases of shock, hemorrhages, infection, gas gangrene, thoracic cases, removal of foreign bodies, and in some brain cases.

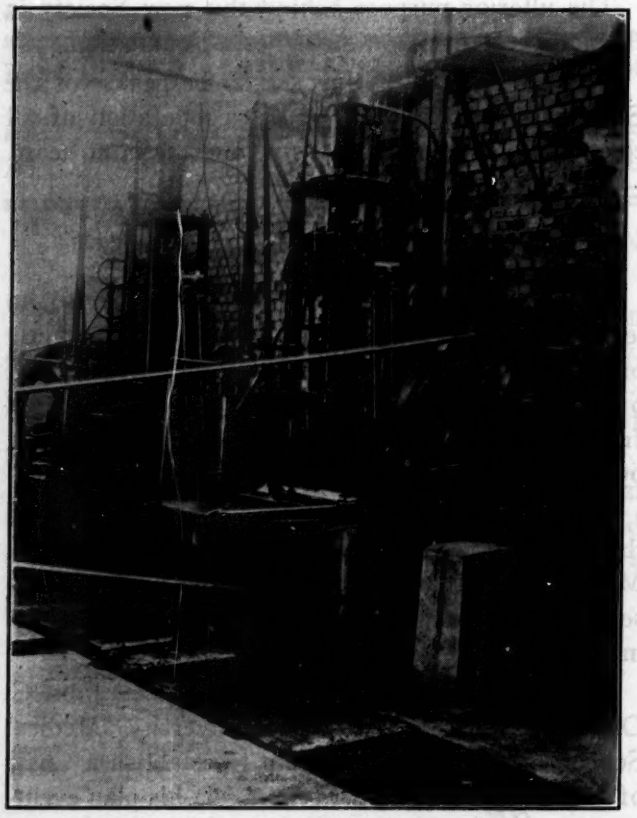

Fig. 2—Gas-compressors in the American Red Cross Plant in Paris.

At the time the armistice was signed, the nitrous oxid service had facilities for supplying every hospital in France. Thousands of our soldiers' lives had been saved by its use, and it was through the efforts and enthusiasm of the Americans that the British adopted its use more generally, while the French were beginning to credit its value.

One lieutenant colonel, who believes in "rendering unto Cæsar," sums up his general opinion:

"Without the American Red Cross backing, this work could not have been done, nor could its clinical application have been possible had not the Red Cross fostered the manufacture and delivery of nitrous oxid and provided an apparatus for its administration."

Abstracts

A Résumé of the International Current Literature of Anesthesia and Analgesia

Increased Alkalinity of the Blood in Shock. B. MOORE. *Lancet*, September 13, 1919. Vol. 2, No. 5011.

Moore claims that the outlook on the chemical conditions in shock is all wrong, and this is why the invariably underlying presence of "acidosis," to which at first much attention was given, became later neglected. All cases of serious secondary shock show so-called "acidosis," but this acidosis is not "acidosis," it is "alkalosis." So all the attempts of physiologists to mimic it have been abortive. When the pressure of free carbonic acid in the blood is decreased then alkalinity rises and kidneys and tissue cells remove alkali from circulation. It is for this reason that the circulating bicarbonate decreases, and so lowered titration figures are obtained, but the blood is more alkaline. A fall in bicarbonate reserve to one-third of normal can be caused by a small fall in pressure of carbon dioxid and accompanying increase in alkalinity. When primary shock occurs from sudden heart failure, from emotional causes, hemorrhage, pain, or some such stimulus, there is cerebral anemia and unconsciousness. There is a general cessation of metabolic activity at first and a shutdown later to about one-third of the normal rate. If there be a closure down in the tissues to one third, what must happen if the lungs go on working at their normal rate or even at one-half their normal rate? An excess of carbon dioxid over that produced must be removed in the lungs and the blood go alkaline, and this is what occurs in secondary shock. During the period of fainting both heart and respiration are held in abeyance, the heart perhaps more than the respiration, and there is a venous condition which favors recovery, but later there is a condition in which respiration exceeds circulation and the blood becomes more alkaline and carries shock to the nerve centers and heart. If as a result of a primary shock the circulation is only working at one-third its usual speed, and the respiration is going on at the usual rate, the amount of carbon dioxid produced will only be one-third of the normal, while elimination proceeds at normaal rate. The result must be that the alkalinity of the blood increases, any such increase leads to heart failure. Hyperpnea need not necessarily be an antecedent factor to surgical shock. In the main, the condition depends on relative rates of circulation and respiration, although other conditions, such as toxic products from wounds and muscle injury and fatigue of nerve centers, undoubtedly play a part.

Tonsillectomy and Thymus Death. H. BURGER. *Nederlandsch Tijdschrift* v. *Genceskunde.* May 31, 1919, Vol. 1, No. 22.

Burger reports the death of a youth of 15 under chloroform for tonsillectomy. The anesthesia and the operation had proceeded smoothly but immediately after the operation had been concluded, the heart action and respiration stopped. Necropsy showed the thymus more than twice the normal size, and the thymicolymphatic status explained the fatality. This status seems to be paricularly dangerous for goiter operations, and judging from Burger's own case and three he has found on record, the same is true of tonsillectomy. Kofler's fatal case was the only fatality in his 6,000 tonsillectomy cases, and Kafemann's in 10,000. In one of the thymus death cases, death did not occur till the following day, after an interval of respiratory disturbance. In all the others death occurred at the close of the operation, before rousing from the anesthetic. Burger adds that there does not seem to be any certain means for detecting the thymicolymphatic status beforehand; aneurysm or retrosternal goiter may stimulate a large thymus.

DIRECTORY OF ANESTHETISTS

The Supplement herewith begins the publication of the Membership Lists of American and Foreign Associations of Anesthetists so that a more or less complete Directory of Anesthetists may be developed for the interests of all concerned in advancing the specialty of anesthesia. The editor would appreciate having the secretaries of the various associations and societies send him complete lists of their membership with corrected addresses. The editor also desires the names and addresses of those not affiliated with any organization, but who routinely administer anesthetics. Any information for making this Directory more accurate or complete will be appreciated.

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Society Proceedings

Membership in a society devoted to your specialty is an essential to success.

AMERICAN ASSOCIATION OF ANESTHETISTS EIGHTH ANNUAL MEETING.

The American Association of Anesthetists will hold its Eighth Annual Meeting in New Orleans, April 26-27, the first two days of A. M. A. Week.

The Hotel Grunewald has been selected as headquarters for the meeting as well as for the scientific sessions.

An interesting and instructive program is being developed for this occasion. Among the papers and speakers tentatively scheduled the following may be mentioned:

Some Anesthetic Relations (Presidential Address). Albert H. Miller, Providence, R. I.

Some Data Regarding Anesthesia for Experimental Surgery, Frank C. Mann, Rochester, Minn.

Some Remarks on Cotton-Process Ether from an Experience of 800 Administrations. Jos. E. Lumbard, New York City.

Combinations of Various Drugs for Induction of Anesthesia and Analgesia by Oral Administration with Report of Cases. A. Ficklen, New Orleans.

Postoperative Pneumonia. Jno. R. Worley, Dallas, Texas.

Deaths Under Anesthesia. Ralph M. Waters, Sioux City, Iowa.

Certain Perfected Methods of Anesthesia for Military Surgery, Especially Neurologic Operations. Ray A. Rice, Columbus, O.

Advances in Pure Gas-Oxygen Anesthesia. E. I. McKesson, Toledo, O.

The Problem of Anesthesia for Major Operations on Infants and Small Children. E. M. Prince, Birmingham, Ala.

Methods of Eliminating the Lay-Anesthetist, George Piness, Los Angeles, Cal.

The Open Method of Administering Gas-Oxygen Anesthesia. J. T. Gwathmey, New York City, N. Y.

Chloroform as a Relexant in Gas-Oxygen Anesthesia. Ansel Caine, New Orleans, La.

A feature of the program will be a Symposium on the Anesthetic Problem in Goiter Operations, during which the following pertinent papers will be presented by well-known authorities on different phases of the subject:

General Considerations. Andre Crotti, Columbus, O.

General Anesthesia for Goiter Operations. Vilray P. Blair, St. Louis, Mo.

Value and Results of Nitrous Oxid-Oxygen and Local Anesthesia in Goiter Operations. Lincoln T. Sise, Boston, Mass.

The Application of Anociation to Goitre Operations. Wm. E. Lower, Cleveland, O.

Thyroidectomy under Local Anesthesia. Carroll W. Allen, New Orleans, La.

Ether-Oil Colonic Anesthesia for Goiter Operations. Walter H. Lathrop, Hazelton, Pa.

The Annual Dinner will be served at the Hotel Grunewald on the evening of April 26, at 6:30 o'clock and will be enlivened with music and clever after-dinner speaking.

For membership, dinner reservations and further particulars, address F. H. McMechan, M.D., Secretary-Treasurer, Avon Lake, O., R. F. D.

Quarterly Index

ALCOHOL INJECTIONS FOR THE RADICAL CURE OF HEMORRHOIDS. I. Boas. Deutsche medizinische Wochenschrift, Berlin, October 16, 1919, Vol. 45, No. 42.

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ANALGESIA, POSTOPERATIVE. Bertha Van Hoosen, Chicago. American Journal of Obstetrics, December, 1919, Vol. 80, No. 6.

ANESTHESIA, GENERAL, TESTS BEFORE. G. Jeanneney. Lyons Chirurgical, May-June, 1919, Vol. 16, No. 3.

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ETHER—OXYGEN ANESTHESIA, ADVANTAGES OF. A. S. McCormick, Akron. Ohio State Medical Journal, December, 1919, Vol. 15, No. 12.

LOCAL ANESTHESIA, APPLICATION OF PURE COCAIN FOR NASAL ANESTHESIA. A. H. Andrews, Chicago. Illinois Medical Journal, January, 1920, Vol. 37, No. 1.

LOCAL ANESTHESIA—BLOCKING THE SPLANCHNIC NERVE. G. A. Preiss and A. Ritter. Centralblatt für Chirurgie, December 27, 1919, Vol. 46, No. 52.

LOCAL ANESTHESIA—BLOCKING THE NERVES FOR OPERATION ON THE LIMBS. Alvaro Guiao. Revista Medico Cirurgica do Brazil, July, 1919, Vol. 27, No. 7.

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National Anesthesia Research Society
Inter-State Association of Anesthetists
New York Society of Anesthetists
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July 1920

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SOME ANESTHETIC RELATIONS.*

ALBERT H. MILLER, M.D.,
PROVIDENCE, R. I.

In an underground cave at the mouth of a narrow tunnel, a watcher sat silent with attention closely fixed upon a shining steel cable which rapidly sped by. The cable, passing from the power house through the tunnel to underground conduits, transmitted power to the surface cars of the metropolis. As long as the cable was intact, all went well but if some strands became broken they would tangle about the clutch of a car which would be carried along helplessly at full speed. The silent watcher noted the condition of the cable as it passed by, ready at the first sign of danger to safeguard the lives dependent upon his care. *Such is one conception of the duty of the anesthetist:—a silent watcher of the thread of life, ready to maintain the integrity of that thread by every means obtainable from study and application.* While this conception of the anesthetist's duty seems to the patient entirely fitting, many of the medical profession would consider the anesthetist an automatic dropping device or an uncalibrated valve.

PRESENT STATUS OF ANESTHESIA.

In the 74 years of its existence, anesthesia has made but little scientific progress and looks out upon an increasingly gloomy prospect for the future. The anesthetic agents which were introduced 74 years ago are still those in use today. Few improvements in methods of administration have been made and these have not been generally adopted. The anesthetic drugs are administered without regard to dosage using the patient as an index to an undefined condition styled "absolute surgical anesthesia." Only sporadic attempts have been made to determine the proper dosage of the powerful agents employed. The refined methods of the laboratory are not made use of in practical anesthesia. Blood pressure apparatus, although of proved value in determining the condition of the patient, is not in general use among anesthetists. *The degree of danger attending the use of anesthetics is still unknown. The more postoperative deaths are studied, the more evident it becomes that a considerable proportion of the mortality is directly or indirectly due to effects of the anesthetic.*

In medical schools, hospitals, and in the medical press, there is a disposition to pay *less*, rather than *more* attention to this subject. The medical preceptor who formerly gave his students instruction in anesthesia is no longer recognized. Medical schools neglect entirely to give instruction in anesthesia or dismiss the subject with an hour's consideration. How is the medical graduate whose knowledge of anesthesia is limited to an hour's study of ether administration with the obsolete closed cone to compete with the nurse who is interested in her work, has studied the literature of the subject and been carefully trained in the use of a good routine method? Can we blame the hospitals for turning more and more to these trained nurses for their anesthetists?

The neglect of anesthesia in the medical schools is partly due to a lack of competent instructors in this department. It is characteristic of modern methods of education that courses of instruction depend upon the availability of instructors rather than upon the needs of pupils.

This condition prevails while the combination of physiology and physical chemistry which provide the foundation for the study of anesthesia can be made the most interesting course in the medical curriculum.

In hospitals, the preoperative examination of patients, the choice and the administration of anesthetics are generally neglected. Recent statistics show that in 603 hospitals of the United States and Canada, in the year 1917, only 27.4 per cent. of the patients received careful physical examination; 1,546,000 patients were admitted to hospitals and discharged without physical examination. (*Surgery, Gynecology and Obstetrics,* March, 1919, xxviii, No. 3, p. 335.) In the institution where an examination is supposed to be made, the data of the examination are frequently not at hand at the time of operation and the physical state of the patient receives no consideration before the operation is performed. No wonder that the necessity for a lame explanation of an unexpected fatality frequently appears. So little attention is paid to the standardization of methods and of apparatus that not only in different institutions but in different departments of the same hospital widely varied methods are the routine. Proper consideration of this topic would show many of these methods to be crude and unscientific and would leave only one or two methods worthy of general adoption. *In many clinics only one agent and one method of administration are available and must be used regardless of the nature of the operation or the condition of the patient.* At the present stage in the development of anesthesia, the minimum provision in a hospital should be for an open method of etherization, an efficient nitrous oxid-oxygen adminis-

*Read before the American Association of Anesthetists, during the Eighth Annual Meeting, Hotel Grunewald, New Orleans, April 26-27, 1920.

tration, and an intrapharyngeal method for work about the face. Many institutions have not manifested sufficient interest to provide these minimum requirements. It is possible to witness delicate operations about the face performed by surgeons of great skill, in the intervals between the intermittent administration of ether with a closed cone.

In the larger institutions, the present conditions may be remedied through the appointment of full-time, resident anesthetists. These officers should supervise the preliminary examination of patients, consult with the surgical staff in the choice of anesthetic agents and methods of administration, supervise difficult cases, instruct juniors in practical anesthesia, and be responsible for the condition of anesthetic apparatus. The unsalaried visiting anesthetist is generally an unsatisfactory member of the surgical staff.

Instruction in anesthesia having been omitted both in medical schools and hospitals, our best trained medical men have no basic knowledge of anesthesia and no experience in anesthetic technic. We are not only neglecting to train anesthetists for present and future needs but are failing to furnish the surgeons of the coming generation with the knowledge of the fundamental principles of anesthesia necessary for the efficient performance of their work. The surgeon of the present time who employs unskilled anesthetists justifies his position by the claim that he is able to oversee the anesthesia. The surgeon of the next generation will not have had the required experience with anesthetics to uphold even this unsatisfactory relation.

The waning interest in the subject is exemplified in the medical literature. Three great medical and surgical journals, in the year 1909 printed seventeen original papers on anesthesia of which eleven were distinct additions to science. In the year 1919, the same journals published only four papers on anesthesia, no one of which could be considered of especial value. On the other hand the daily press continues to publish an increasing list of anesthetic fatalities of the most glaring nature.

REMEDY FOR CONDITIONS NOTED.

The only bright spot in the prospect for anesthesia appears in the activities of the American Association of Anesthetists and its associated societies. Presentation and discussion of papers, consideration of latest and best methods, interchange of ideas on basic principles and technic improve the individual work of the members and raise the general standard of anesthesia. The discussions before these societies is providing an unequalled library of anesthetic literature, ably edited and published in The Quarterly Supplement of Anesthesia. But to fulfill its entire duty, the activities of this association must be stimulated and extended. It must pass from the attitude of passive protest at present conditions to one of active interest in the problems connected with anesthesia. Of the nature of these activities we need not remain in doubt. The foremost medical authority of the time, after an unequalled experience and from an exhaustive study of present conditions has already made the recommendations required for future improvement in the anesthetic situation. With his permission, I quote from an address of Dr. W. W. Keen, delivered at the Massachusetts General Hospital, October 16, 1915, ("The Dangers of Ether as an Anesthetic," W. W. Keen, M.D. LL.D., Philadelphia. Emeritus Professor of Surgery, Jefferson Medical College. Address delivered at the Massachusetts General Hospital, on the sixty-ninth anniversary of Ether Day, October 16, 1915):

"Prior to the operation the anesthetist as well as the surgeon should make himself familiar with the condition of the heart, kidneys, blood pressure, hemoglobin, and any unusual condition; should see that the mouth, tongue, teeth, and tonsils are in proper condition, and that provision be made to prevent chilling of the patient,—an important point never to be overlooked.

"During operation the anesthetist should attend strictly to his own business. He should glance at the operation only from time to time, not to study the operation, but in order to anticipate the need for lighter or deeper anesthesia and when the anesthesia may be stopped. Of course he should keep himself constantly informed of the general condition of the patient by observation of the respiration, the most important function of all, of the blood pressure, pulse, pupil, color, and condition of the skin as to sweating.

"The use of an anesthesia chart in every case. I am persuaded that a chart tends to concentrate the attention of the anesthetist upon his 'job' and make him more careful. In a few years such charts would also furnish us with very valuable and extensive statistics. The form should be full enough to make it valuable and to compel the average anesthetist to make close and continuous observation, yet not so elaborate and detailed as to defeat its own object. Instead of distracting the attention from the pataient, these records fix the anesthetists' attention much more closely upon the patient's condition than if no chart is used.

"Observation and charting of the blood pressure not only beforehand, but at frequent intervals dur-

ing every important or prolonged operation, especially as a guide to the degree of shock. Accurately known blood pressure is of greater value than the rate and quality of the pulse and gives warning from 5 to 20 minutes earlier than the pulse.

"Straight ether by the open drop method as a routine method instead of mixtures and sequences. I believe all the latter to be more dangerous than ether.

"More accurate dosage of the ether on the basis of its anesthetic tension, i. e., the partial pressure of the ether vapor in the inspired air. Science began with the substitution of the balance, the yardstick and the clock, for even the most accurate guesses as to weight, dimension and time. In anesthesia the same I feel must hold good. A knowledge of this concentration or anesthetic tension cannot be obtained by observation. It must be by exact measurement in millimeters of mercury.

"Many professional anesthetists. In order that medical men and women shall devote themselves to anesthesia as a specialty, the public must be taught that safety lies in having an expert anesthetist, and that like any other expert, if he is to obtain a living as such, he must be well paid, otherwise he cannot devote his whole time to the specialty.

"The collection of statistics at intervals of five years.

"Instruction of all medical students in the theory and practice of anesthesia. Next to the surgeon and even before his first operative assistant, in my opinion, stands the anesthetist, holding the scales of Life and Death. It should be the duty of our medical schools and their hospitals to instruct all students in anesthesia and to give them experience by having them administer anesthetics under the supervision of their experts. In view of the constant and necessary change of internes there should be on the staff of each division a permanent expert. In small hospitals at least one of the staff should make it his business to become an expert by constant study and practice."

No words of mine can add to the authority of the author quoted whose name Sir William Osler has included in the list of most eminent medical men of our time. We are fortunate in having so clear an exposition by so able an authority and cannot afford to neglect his suggestions as they bear upon our individual work and the activities of our association. The status of anesthesia depends first upon the character of the individual work of those who are at present administering anesthetics. To the individual members of this association who are seeking a guide for their daily work I commend a study of the address from which quotations have here been taken. The preliminary examination of patients who are to undergo surgical operations, the choice of the anesthetic, a routine method brought to as near practical perfection as is possible with our present imperfect methods, the mastery of such accessory methods as may be required by special conditions of patient or of operation, availability of all requisite apparatus, the routine use of blood pressure tests, an efficient system of records for each case and for cases collected in series, study of the causes of postoperative complications and mortality, and the collection of fees adequate to maintain the respect of the community; these are matters of concern for each member of our association.

For concerted action by the association, I suggest:

1. Encouragement of joint sessions of anesthetic societies with surgical societies as initiated by the Interstate Association of Anesthetists and the preparation of symposiums on subjects of interest common to anesthesia and to surgery.

2. A committee on statistics. This committee cannot be expected to make great progress in the collection of statistics during the present year but can review the situation, learn what records are being kept and report to the next annual meeting on the statistics at present available and the procedures required for continuing this work. Anesthetic mortality is not reported in municipal death returns nor in hospital reports. Many of the deaths would be reported to a committee which was generally known to be interested in the question. Such returns should be designated by date and locality and not by the name of any person concerned. The action of the National Anesthesia Research Society in regard to anesthesia records promises to be of great value in this connection.

3. A committee on Instruction in Medical Schools. It should be possible to find in this association a number of men who will volunteer to prepare a course of three lectures on the principles and practice of anesthesia and to deliver them at first grade medical schools during the coming year. The work of this committee would then consist in corresponding with medical schools, finding those which are desirous of obtaining instruction in anesthesia, and bringing these schools in touch with the men who are willing to provide lectures. From some experence in this work I judge that the medical students would welcome such instruction gladly.

4. A committee on Anesthesia in Hospitals. This committee also could not be expected to make great

progress in a single year. The Council on Medical Education of the American Medical Association has made several surveys of the hospitals and has secured answers to the following questions in regard to anesthesia:

Are anesthetics in charge of an expert anesthetist?

Equipment for anesthetics?

Work of Internes, Anesthetics?

This Council has found that 584 of 801 hospitals employ expert anesthetists. It includes under the essential requirements for hospitals: "Anesthetics: The interne should obtain experience in the administering of various anesthetics under expert supervision." The National Anesthesia Research Society is sending out an exhaustive questionnaire on anesthesia in hospitals from which valuable information should be secured. The committee on Anesthesia in Hospitals of this association could cooperate with these agencies and report on the progress made to the next annual meeting. Some time ago a writer in *The Journal of the American Medical Association* reported as to anesthesia in hospitals *"during the past few years I have seen some of the most atrocious examples of this work in the clinics of surgeons of national and international reputation that I have ever observed anywhere."* (Moriarta, *Jour. A. M. A.*, Sept. 4, 1909, liii., No. 10, p. 768.) If such conditions exist at the present time this association needs to take an active interest in the situation.

5. A committee on Anesthetic Agents and Methods: A number of men competent to report on the agents and methods in use that the association may take action toward standardizing agents, methods, and apparatus and bring some order out of the present chaotic conditions. The position of chloroform and ethyl chlorid in the anesthetist's armentarium, the status of intratracheal and intrapharyngeal anesthesia, of intravenous, rectal, and spinal anesthesia, the essential features of an efficient nitrous oxid-oxygen apparatus are matters concerning which this association should have well formulated and clearly stated opinions. The committee on Anesthetic Agents and Methods has material for reports for many years to come.

The neglect of the subject of anesthesia in medical schools, hospitals and the medical press, and the indifference of the profession to anesthetic conditions must stimulate the members of the American Association of Anesthetists to increased activity or improvement in the present anesthetic situation cannot be made. The required line of action has been clearly outlined by one of the foremost authorities of the time. The recommendations of this authority should be adopted at this meeting as a guide to the activities of the coming year.

131 WATERMAN STREET.

SOME RESULTS FROM ANESTHESIA EXPERIMENTS ON ANIMALS.*

W. I. JONES, D.D.S,
and
CLAYTON MCPEEK, M.D.,
COLUMBUS, OHIO.

This paper will be the consideration of mixed anesthesia in experiments, the fundamental or principal agent of which was nitrous-oxid, because all anesthesias are very apt to be a combination of different sleep-producing drugs, the principal ones of which are ether, chloroform, nitrous-oxid, morphin, scopolamin, cocain, ethylchlorid and chloral, all of which the successful anesthetist should know how to use.

In preparing this paper we have thought it best to present it under six different headings. First, its history; second, pharmacology; third, physiological effects; fourth, technic of its administration; fifth, advantages, and sixth, disadvantages.

HISTORICAL CONSIDERATIONS.

Its history we will dismiss with a few words. Suffice it to say, that the evolution of general surgical anesthesia is steeped in tradition, and it is almost impossible to say at what period of the world's history men began to make attempts to relieve pain. It would be a pretty safe guess, however, to say that it was among some of their earliest efforts, one of the primitive modes of inducing anesthesia was by strangulation, thus producing anoxemia and asphyxia. Nitrous oxid was given to the world in the early forties of the last century. Nitrous-oxid and oxygen in 1868 by Dr. Andrews of Chicago.

PHARMACOLOGY.

Its preparation we will also briefly consider by saying that it is obtained by the decomposition of amonium nitrate into water and the gas N_2O.

PHYSIOLOGICAL EFFECTS.

Several theories have been advanced as to the way in which nitrous-oxid produces anesthesia, and it is not necessary now to take up your time by rehashing all the old theories. We are pretty thoroughly convinced by our own clinical experiences and laboratory experimentations, as well as by that

*Read before the Section on Physio-Pathology of the Interstate Association of Anesthetists, during the Fifth Annual Meeting, at Cincinnati, September 15-17, 1919. From the Experimental Laboratory of Physiology of the Ohio State University Medical Department.

of other anesthetists and laboratory men, that we have a more definite knowledge of the way in which nitrous-oxid produces anesthesia than we have about any other anesthetic.

Nitrous-oxid outside the body supports combustion, while in the tissues, other than the central nervous system, it acts like any other indifferent gas. Animals die when placed in it, seeds will not germinate in it, or plants grow, and the blood of an animal killed by it contains no oxyhemoglobin.

Nitrous-oxid has a special effect on the central nervous system by reason of the excluding of oxygen. If it were an indifferent gas, no effects should be obtained with a four-to-one mixture because ordinary atmospheric air is four parts of nitrogen and one part of oxygen.

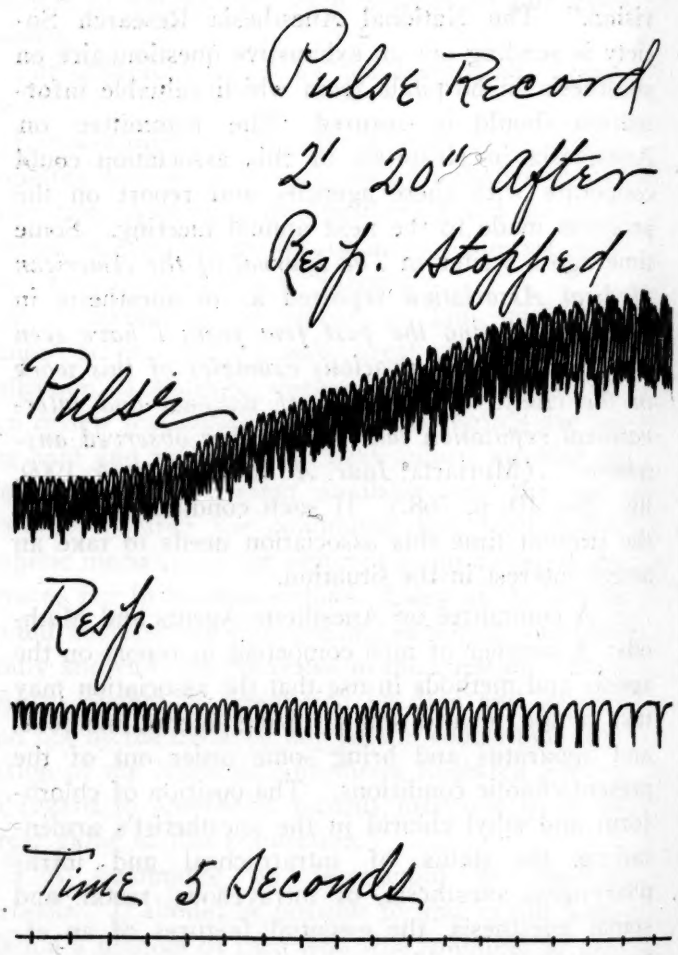
Blood dissolves more nitrous-oxid than water, apparently for the reason that it is taken up by the lipoids of the corpuscles in much the same way that chloroform is.

It is introduced by way of the respiratory tract into the lungs, when it is distributed throughout the alveoli of this organ where it is taken up by the blood, but upon which it has no specific chemical effect, the resultant anesthesia being produced by some alteration of the oxygenating processes in the human body. This sub-oxygenating process beginning back in the pulmonary circulation where, owing to the supply of oxygen being cut off, the venous blood of the pulmonary artery passes unchanged into the minute radicles of the pulmonary veins, causing more or less stagnation, which results in a general anoxemic condition that may quickly develop into asphyxiation, unless much skill is used in the proper mixing of the gases, and a much closer watch kept over the respiration, pulse and color of the patient than is necessary when using ether.

The fact that nitrous-oxid anesthesia can sometimes be produced without any apparent or easily discovered cyanosis, does not prove that anesthesia is not the result of a diminished or altered supply of oxygen, because in fact it is the increasing or diminishing of the oxygen which determines the depth of the anesthesia, and profound anesthesia is frequently obtained, especially in the very anemic, or those with a low hemoglobin test, without the slightest apparent sign of cyanosis being present—so that those of limited experience may easily be mistaken in reading the signs of anesthesia. In other words, nitrous-oxid anesthesia is a general anoxemic condition, whether cyanosis is present or not, in which the brain cells partake of the general anoxemia, thus preventing the recording of pain sensations, because the brain cells, like the pulmonary veins, only functionate in the presence of oxygen. If we had asphyxia to a lethal degree, there would be a total cessation of all the processes of life. In anoxemia we have a partial cessation or anesthesia; and if those surgeons and anesthetists who are complaining so loudly of their bad results will maintain anoxemia, instead of cyanosis and asphyxia, they will have little reason to condemn one of the greatest advances of modern surgery.

HOW DOES N_2O PRODUCE DEATH?

Nitrous-oxid when given to a lethal degree does not produce death by paralyzing the heart muscle,



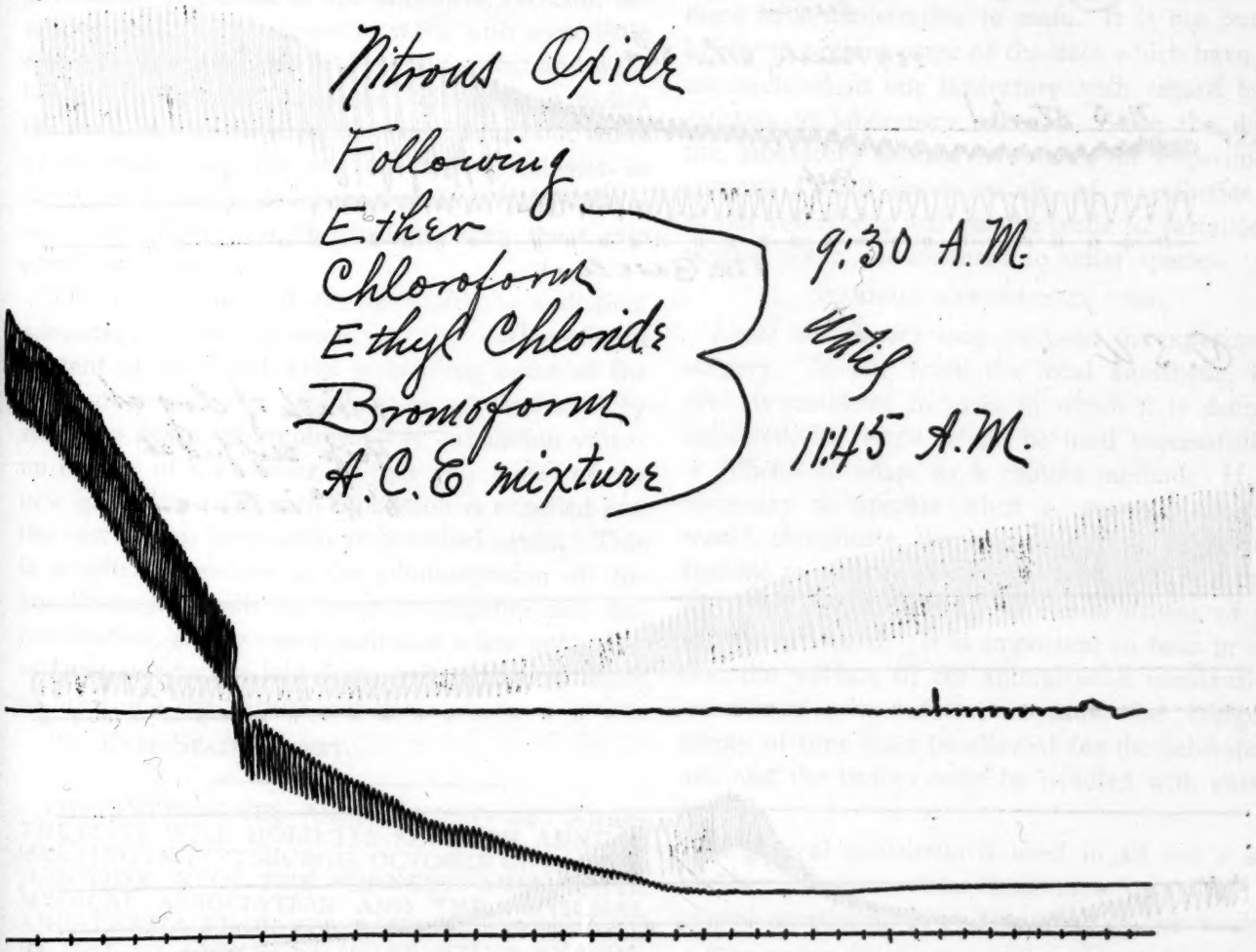
as has been stated by some surgeons, but by its paralyzing affect upon the respiratory center. Of this we are convinced by large clinical experience of many thousands of administrations for all sorts of surgical operations, and more recently by laboratory experiments carried on in the laboratory of the Ohio State University Medical Department, by Dr. Clayton McPeek, Assistant Professor of Physiology in that university, and myself. Our object was to determine which was the first to succumb to the use of N_2O when used to a lethal degree. In all of our experiments the same phenomena were present in every case, *viz.*, when surgical anesthesia was

produced and maintained, a beautifully rhythmical pulse and respiration were the result, but when oxygen was shut off and nitrous-oxid was used for the express purpose of producing the death of the animal, the blood pressure was suddenly increased, the respirations became more rapid and finally death ensued from asphyxia. In one case the heart continued to beat for as much as five minutes and forty-five seconds after the last gasp of respiration. Inasmuch as rescuscitation was possible immediately after the cessation of respiration, the conclusion was reached that the viability of the respiratory center was less than that of the cardiac.

ulation of the cardio-depressor center, and of the depression of the cardiac muscle fibers as well. This occurs even though the reflex paths are cut, and when the chloroform concentration reaches 0.15 per cent. the subjects (dogs) were taken irrespective of age, sex or previous condition. Some had been used as subjects for pysiologic experimentation, having had half a dozen or more drugs injected, and being under ether or chloroform anesthesia for as much as three hours. Others were taken fresh from kennels.

TECHNIC OF ITS ADMINISTRATION.

The administration of gas-oxygen, for general



Several of the dogs had one or both of the vagus nerves severed; death from a too rich mixture of nitrous-oxid showed the same features, although impulses were no longer able to travel over the vagus.

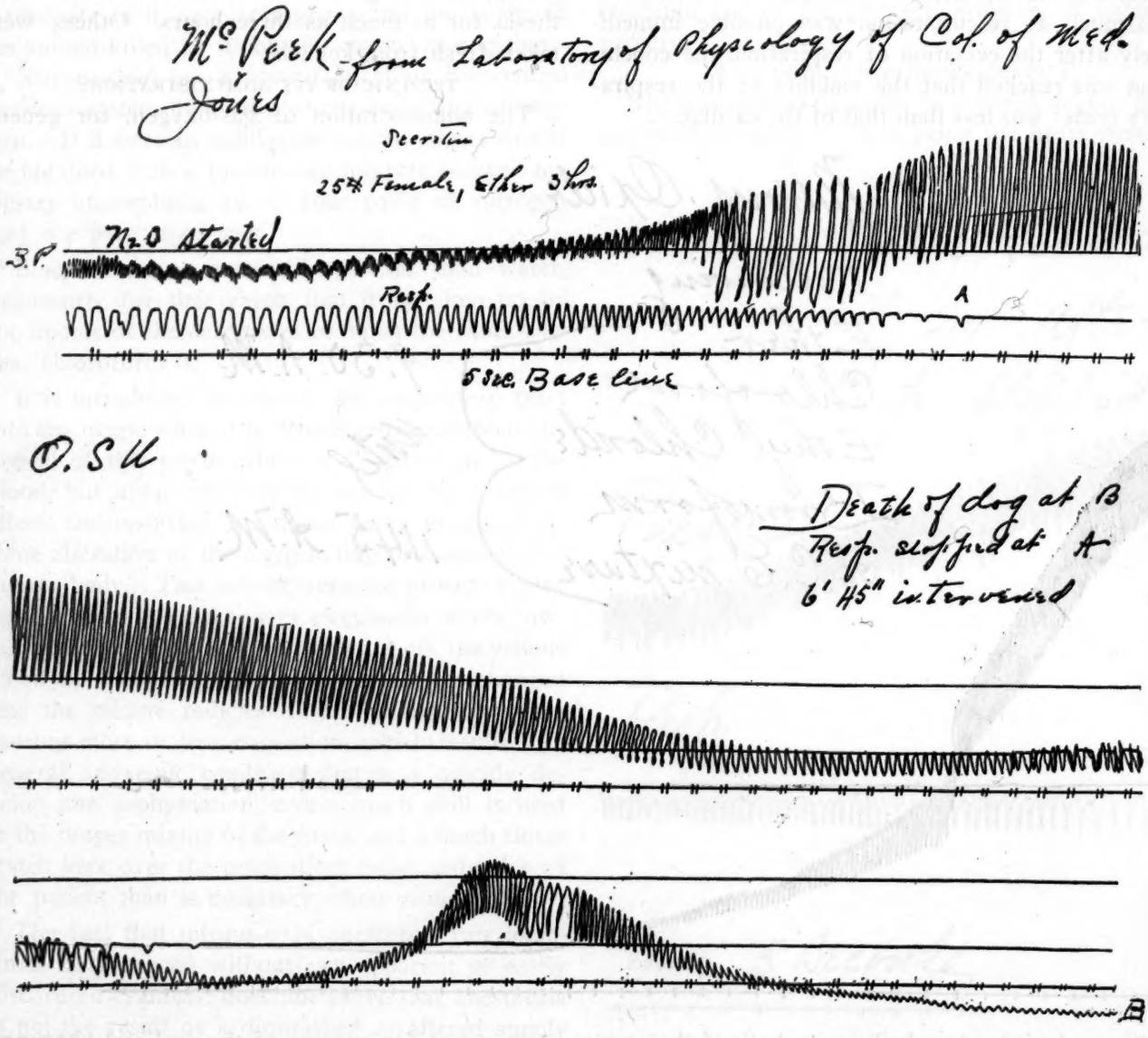
The independent resistant element of the heart muscle to oxygen deprivation must be considered as a favorable feature. According to the experiments of Bert and Martin, death results from a lack of oxygen, rather than to the presence of the nitrous-oxid. All the nerve cells are depressed, hence depression of the center is of considerable importance. In chloroform narcosis there is both a direct stim-

surgery, or for surgery of the oral and pharyngeal cavities, are similar in that a steady, even flow of nitrous-oxid, under a constant positive and low pressure, are absolutely necessary, remembering all the time that nitrous-oxid is the sleep-producer, and that oxygen is simply the agent that regulates the depth and character of the anesthesia. All connections and pipes leading from the gas cylinders should be absolutely free from obstruction and air-tight. The tube leading from the mixing chamber on the gas machine should be large enough to permit the patient to get all the gas and oxygen necessary without any effort on his part. The inhaler should

be large and comfortable and fit over the mouth and nose absolutely air-tight.

If the operation to be performed is, let us say, an abdominal one, the nitrous-oxid cylinders are opened and the pressure gauges turned until they register a pressure of ten pounds. This indicates to us that the gas is leaving the cylinder under a pressure of ten pounds. It is further reduced by the automatic valves from the gas machine to a pressure of not over one-half ounce. The bag should not be distended to its capacity, but should be allowed to inflate and deflate with each respiration. The oxygen cylinder should be under a little greater pressure than the nitrous-oxid cylinder.

Now, after the gases are turned on and are flowing into the bag or bags, the face piece should be adjusted, and not before, because it is very disquieting to a patient to have his face clapped into an air-tight receptacle and not have anything to breathe. It is advisable, and it is our plan, to administer several inhalations of pure nitrous-oxid before any oxygen is used, as the patient will come under the influence of the anesthetic more quickly and with less excitement after three or four inhalations of nitrous-oxid, then introduce oxygen, say two or three per cent., gradually, increasing or diminishing the amount as the case may require.



No hard and fast rule can be laid down as to the percentages of gas and oxygen to be used, and notwithstanding the claims of the manufacturers, the machine has not yet been made into whose unreasoning power the patient can be intrusted while the anesthetist enjoys the society of those around him. The patient is the thing to watch, and not the machine. This is one of the reasons, it seems to me, that some have had trouble with this anesthetic. They assume that the apparatus was all that was

required, and that knowledge and experience were unnecessary. Enough oxygen should be used to prevent cyanosis, although a degree of cyanosis is not objectionable or dangerous; much depends upon the patient as to the amount of cyanosis permissible. If the patient takes the anesthetic badly, or if a proper degree of relaxation is not possible without too much cyanosis, then it is far better and safer to introduce some ether along with the gas-oxygen, than to attempt to get relaxation with gas-oxygen alone, and the amount of ether used is a pretty good indication of two things: first, the skill of the anesthetist in the use of the anesthetic; second, the willingness of the surgeon to work with some little disadvantage to himself, but more comfort and well-being to his patient. No one claims that it makes the surgeon's or anesthetist's work easier, but many of the most prominent surgeons and physiologists in the United States do claim that it is many times safer and better for the patient when these two conditions exist.

The re-breathing of the anesthetic is a distinct advantage in that it preserves the carbon-dioxid content of the blood, (the stimulating agent of the respiratory center). This can be accomplished by screwing down the expiratory or exhalation valves on the top of the inhaler, so that only a part of the new gas taken in at each inhalation is expelled and the rest of it is necessarily re-breathed again. This is another procedure in the administration of this anesthetic that calls for some intelligence and discrimination, and as every patient is a law unto himself, no rule can be laid down as to just how much re-breathing the patient can do.

185 EAST STATE STREET.

THE INTERSTATE ASSOCIATION OF ANESTHETISTS WILL HOLD ITS SEVENTH ANNUAL MEETING IN PITTSBURGH, OCTOBER 4-7, IN CONJUNCTION WITH THE PENNSYLVANIA STATE MEDICAL ASSOCIATION AND THE NATIONAL ANESTHESIA RESEARCH SOCIETY. THIS WILL BE ONE OF THE MOST INTERESTING AND IMPORTANT MEETINGS EVER HELD, AND ALL ACTIVITIES WILL BE CENTERED IN THE HOTEL WILLIAM PENN.

THE NATIONAL ANESTHESIA RESEARCH SOCIETY WILL AWARD MONEY PRIZES FOR THE THREE BEST PAPERS PRESENTED ON RESEARCHES IN ANESTHESIA. THOSE WISHING TO COMPETE SHOULD GET IN TOUCH WITH THE SECRETARY AT ONCE.

ON THURSDAY AFTERNOON, OCTOBER 7, THERE WILL BE A JOINT SESSION WITH ALL THE SECTIONS OF THE PENNSYLVANIA STATE MEDICAL ASSOCIATION WITH A PROGRAM OF PERTINENT PAPERS OF INTEREST TO ALL IN ATTENDANCE.

IF POSSIBLE CLINICS TO DEMONSTRATE THE LATEST ADVANCES IN ANESTHETIC TECHNIC WILL BE HELD EARLY IN THE MORNING, PREVIOUS TO THE SCIENTIFIC SESSIONS.

ANESTHESIA IN EXPERIMENTAL SURGERY.*

F. C. MANN, M.D.,
ROCHESTER, MINNESOTA.

The large number of inquiries I receive each year concerning the technic of anesthesia in experimental surgery, and the askance with which most veterinarians view the administration of an anesthetic, leads me to believe that the successful administration of anesthesia in experimental surgery and veterinary practice, lags far behind its development in administration to man. It is my purpose briefly to present some of the data which have been accumulated in our laboratory with regard to anesthesia in laboratory animals. Since the dog is the laboratory animal of choice in experimental surgery I shall speak mainly of anesthetics for it, but references will also be made to variations in technic when administered to other species.

VARIOUS ANESTHETICS USED.

Local anesthetics may be used in experimental surgery. In our work the local anesthetic, however, is restricted to cases in which it is definitely indicated, for while it can be used successfully, it is difficult to adapt as a routine method. If it is necessary to operate when a general anesthetic would complicate the experiment, it is perfectly feasible to employ any of the best local anesthetics with the assurance that no consciousness of pain will be produced. It is important to bear in mind that the welfare of the animal must constantly be considered; the infiltration must be complete; plenty of time must be allowed for the substance to act, and the tissues must be handled with extreme care.

A general anesthetic is used in all but a small number of cases. The three most commonly employed anesthetics have been used in our work.

Too many disadvantages are attached to the use of *chloroform* as a routine measure. For example, it is difficult to train an anesthetist to give chloroform successfully, and in a large number of cases, its post-anesthetic action will defeat the purpose of the experiment. Under some very definite conditions, however, when a short, quick anesthetic is desired, chloroform may be used by those skilled in its administration.

Nitrous oxid-oxygen may be used (Dolley), but it does not maintain a constant anesthesia in labora-

*Read before the American Association of Anesthetists, during the Eighth Annual Meeting, Hotel Grunewald, New Orleans, April 26-27, 1920. From The Division of Experimental Surgery and Pathology, Mayo Foundation.

tory animals (Jackson)[4] and its method of administration and cost preclude its routine use.

Ether is without doubt the best anesthetic to use for most laboratory work. Our method and technic of anesthesia has been developed for the use of this substance. Of course for purely physiologic work, many other substances such as urethrane and chlorotone may be used.

PROBLEMS CONNECTED WITH ANESTHESIA FOR EXPERIMENTAL SURGERY IN ANIMALS.

Several problems connected with anesthesia in experimental surgery are not found in the application of anesthesia in operations on man. For instance, the reaction of the various species is slightly different with the different anesthetic substances. Their reaction to ether seems to be more uniform than to any other general anesthetic. As the respiratory rate and probably certain factors with regard to the control of respiration are different in the various species, we find that slight details in the administration of the volatile anesthetics also differ. This is an important fact for the anesthetist in the experimental laboratory. Another difficulty is the usual necessity of training for an anesthetist in the laboratory someone who is unfamiliar with medicine, anesthesia, and laboratory work, and it is usually imperative that the anesthetist shall do many other things beside giving the anesthesia. These facts should be considered in selecting any method of anesthesia in the laboratory.

AUTO-INHALATION AS A ROUTINE METHOD.

Through several years of experience, we have found the method of anesthesia, herewith described, very satisfactory. It was first devised by McGrath[6] and termed the auto-inhalation method. We have adapted it with a few changes to our own particular work. The method consists in an initial etherization of the animal in a closed cabinet, intubation on the operating table, and the maintenance of the anesthesia by attaching a simple ether can to the intratracheal tube.

The pre-anesthetic treatment consists only in withdrawal of food for at least twelve hours; this is sufficient so far as the anesthetic is concerned, but it is usually necessary to fast the animal for from eighteen to twenty-four hours, depending on the operative procedure planned. The animals are given water freely. Atropin and morphin are not given, except for special reasons, it is not necessary nor advisable to administer the drugs routinely.

The etherizing cabinet is a galvanized iron box with a hinged lid. It may vary in size, but should be large enough to accommodate the largest dog. I have found it better to have it slightly larger than seems to be necessary, since this tends to prevent accidents in the initial etherization although it does require more ether. The cabinet that we found most generally useful is 75 cm. long, 50 cm. wide, and 60 cm. deep. This size is very convenient to use but larger than necessary. There are two glass windows in the lid, and a funnel leads to a sponge within a wire basket attached to the under surface of the lid. A rubber rim makes the lid fit snugly and practically air-tight. If it is necessary to administer a large number of anesthetics, two of these etherizing cabinets can be used to advantage, one large enough for the very large dogs and a smaller one for the small and medium-sized dogs.

The animal is placed in the etherizing cabinet, the lid closed securely, and ether poured through the funnel until it saturates the sponge. The funnel is then closed by setting the ether can on the top of it. The ether soon vaporizes, but the tension necessary to saturate the blood to the degree which will produce surgical anesthesia is produced slowly; the animal usually struggles little and makes practically no noise. The time necessary to produce complete relaxation varies with the different animals. The average is ten minutes. This time can be decreased to four minutes by forcing ether vapor in the cabinet as advised by McGrath.[7] A heater under the funnel also vaporizes the ether quickly and decreases both the amount of ether and the time necessary to produce relaxation. As soon as the animal is completely relaxed, it is placed on the operating table and intubated, and the ether can connected.

Intubation in the dog is simple, provided three necessary conditions are fully maintained. *First,* the animal must be anesthetized to full surgical anesthesia. *Second,* the body must be perfectly straight and the animal on its back. *Third,* the tongue must be pulled forward in a perfectly straight line. The latter procedure throws the glottis in full view and a metal tube can be inserted into the trachea. With this method of auto-inhalation, the diameter of the metal tube should be such that it almost completely fills the trachea. It should be inserted down to the bifurcation and then retracted 3 or 4 cm. The time necessary for intubation and attaching the ether can is seldom more than one or two minutes.

The ether can may be simple, or complex, as desired. On the whole I have found the simplest kind to be the best. The one generally used by us is made from an ether container in which two

small straight metal tubes have been soldered in the top. To one of these is attached a T tube connected by rubber tubing to the intubation tube. A small valve in the T tube allows the entrance of air which does not contain ether vapor. A small piece of paper is pasted to the other opening in the can; this acts as an indicator of the rate of respiration. The animal breathes the air over the ether which contains a relatively high ether tension. The anesthesia when once regulated, can be maintained for an hour or more without any further attention of the anesthetist.

There are several other ether containers which may be used. For example one described by Guthrie, made of a mason glass jar; the one devised by Jackson,[5] and the container in the insufflation machine of Adson and Little. In all of these, one-way valves may be included.

ADVANTAGES AND DISADVANTAGES OF THE CLOSED CABINET METHOD OF ETHER INDUCTION.

The closed cabinet method of anesthesia has many advantages and some disadvantages. By starting the anesthesia in an etherizing cabinet the animal goes under slowly with just enough anesthetic tension to produce anesthesia, thus making the initial administration, which is ordinarily the most dangerous part of the procedure, relatively safe. The animals rarely become over-etherized in the ether cabinet. Furthermore, the average animal passes into a state of anesthesia with the minimum amount of struggling and without relaxation of the bladder or anal sphincters. Since the cabinet is airtight and large, there is a limited amount of rebreathing during the period of initial etherization, when rebreathing is probably of the greatest value. The procedure requires only one anesthetist, who may render other assistance while the animal is slowly reaching the anesthetized state.

The two possible disadvantages in this method of etherization are *first,* that it requires more ether than the old-fashioned cone method, and *second,* a somewhat longer time for the animal to become anesthetized. The latter disadvantage need be of no consequence in loss of time, however, since the anesthetist may be occupied with other work.

The simple ether-can method requires a slightly larger amount of ether than some of the other methods, as the animal, in breathing back over the ether surface, blows out the same proportional amount of ether as is drawn into the respiratory passage. This can be obviated by the use of two one-way valves. In our experience, however, the additional respiratory effort necessary to operate these valves and the increasing complexity of the apparatus, have seemingly more than offset the advantages of their use and the saving of ether, although in the hands of a well-trained anesthetist they may be satisfactorily manipulated.

In general, the advantages of the cabinet inhalation method are many: An even anesthesia may be maintained; the anesthetist after starting the anesthetic can devote most of his time to other duties, and the animal is very easily kept under light anesthesia from which it comes out quickly after the operative procedure has been carried out. In our laboratory it is always planned to have the animal completely out of the anesthesia within one hour after completion of the operation.

METHODS OF ANESTHESIA FOR VARIOUS SPECIES OF ANIMALS.

Although the last described method of anesthesia is of the greatest value in the dog, we have been able to adapt it to some of the other species, such as the goat, cat, and rabbit. Most of the other species, either because of their small size or their reaction to the anesthetic, demand more attention. I know of no better manner of etherizing the guinea pig and the rabbit than by the old-fashioned cone method in which the cone is made from a small towel. This also works very well with the cat following a preliminary etherization in a bell-jar or some other small container .

The goat is one of the most difficult animals to anesthetize. Preliminary drug medication is preeminently useful in this species. The dosage, however, must be large. One-fourth grain of morphin and one-fiftieth grain of atropin should be administered to the average animal. Even these do not wholly stop the flow of mucus, and there is danger that the animals will choke to death. In a few experiments in which the saliva and mucus secreted by the goat were measured, they were found to total more than one liter each hour. If the animal's head is not in a position to allow the flow to drain, the animal will drown in his own secretion. Intubation and the use of the Connell anesthetometer is the best method of etherizing the goats. Intubation is not so difficult as it would seem; it must be done by touch, however, as it is impossible to obtain an exposure of the opening into the larynx.

All other species which we have attempted to adapt to laboratory work, such as the hog, and the sheep, have been relatively easily anesthetized by the cone method.

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ACCIDENTS DURING ANESTHESIA.*

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Unfortunately, instruction in the art of anesthesia has been so neglected in the past that most persons who attempt it as a specialty have been under the necessity of acting, to a large extent, as their own teachers. Portions of the literature of anesthesia that have been found most instructive to me have been the *very* occasional case reports of accidents occurring during administration. It is my purpose then today to report to you five fatal accidents, during a practice of the specialty covering eight years, with their lessons. At some future date I shall beg the privilege of reporting a series of non-fatal accidents of a serious nature occurring during the same period. If in so doing, a repetition of my errors, by some one else, may be prevented I shall deem myself well repaid.

LACK OF PROPER MORTALITY STATISTICS.

I had hoped to present you with really scientific statistics as an introduction but such data I find more than difficult to obtain. A scattering few reports of 35,000 and 50,000 administrations without a death, and mention in some text books that the death rate from chloroform is 1 in 3,000, ether 1 in 10,000 and nitrous oxid-oxygen 1 in 100,000 is the best obtainable. The Military Medical reports for the past three years are not yet available, I am sorry to say.

Several years ago Dr. M. Salzer, of Cincinnati, collected Coroner's and hospital statistics on anesthetic mortality within a radius of 200 miles. From those that would supply data it was found that deaths under anesthesia averaged between one in four to six hundred administrations. More recently Dr. Stewart, of the same city, has compiled statistics of 10,700 operations, for removal of tonsils and adenoids, in the same territory, and found that 20 deaths had occurred in the series, or one death in less than six hundred administrations.

Sir A. L. Fleming, speaking to the Section on Anesthetics of the Royal Society of Medicine in London, reports 700 deaths occurring during or immediately following anesthesia, in three years, but his data again was gleaned from Coroner's reports in the daily papers, for want of better material. I quote from his report a paragraph with which I most heartily agree.

"It seems a great pity that we cannot devise some method by means of which we might obtain full and accurate account of all instances where an anesthetic kills, helps to kill, or threatens to kill. One naturally wonders whether this Section could not do something in the direction of inducing anesthetists to report their difficult cases so that we might have the advantage of their experience. As an illustration of the incompleteness of many of the reports, we find that in only 542 of the 700 cases included in the review is mention made of the nature of the anesthetic employed. The first point which attracts our attention is the number of fatalities occurring, with melancholy regularly in different parts of the country (England)."

THE EXPERT AND THE GREATER PERCENTAGE OF HAZARDOUS RISKS.

The routine administration of anesthesia over a goodly portion of the United States today is done by internes, nurses and office assistants which forces, to a large extent, the occasional doubtful case to the door of the specialist in this line. His percentage of poor results may therefore be great. But is that an excuse for his not reporting his misfortunes if for no other purpose than that of their instructive value?

During the eight years of my experience, administrations have totaled approximately 7,200. This includes some eight or nine hundred administrations during hospital interneships. *The 5,000 administrations during the last five years have included a goodly number of cases referred to me because doubt was probably present as to the advisability of using the routine anesthetist ordinarily employed.* Nearly all during the last five years included the use of oxygen with nitrous oxid or ether or both.

CASE REPORTS.

CASE I. (March, 1914). A boy eight years old under osteopathic treatment for general peritonitis during the previous three weeks. Abdomen tense with pus and patient in extremis. Nitrous oxid was administered with a small percentage of oxy-

*Read before the American Association of Anesthetists, during the Eighth Annual Meeting, Hotel Grunewald, New Orleans, April 26-27, 1920.

gen and incision made. The pus shot into the air and he was dead. The whole procedure was over too quickly to make observations. *The case is almost devoid of teaching value except that the possibility of saturating this child with oxygen first and gradually introducing small percentages of either nitrous oxid or ether might have bettered the result.*

CASE 2. (May, 1916). Mrs. C. Age 61, weight 250 lbs, deeply jaundiced and septic. Diagnosis, stone in the common duct of the bile tract. Delay and administration of sedative drugs before administering nitrous oxid and oxygen was advised against by the internist consultant as also was suggestion of ether as a possible choice. Nitrous oxid and oxygen induction was then attempted, using a small percentage of oxygen. At the beginning of the operation the pupils dilated, then the respiration ceased and lastly the pulse. Pure oxygen was not available immediately and under pressure enough to inflate the lungs due to the type of apparatus then in use.

DEDUCTIONS:—*First*: An anesthetist must use his own judgment as to drugs and method of administration. He alone should know what drug or drugs he can the most wisely use in a given case.

Second: His judgment should include an ability and equipment to recognize a toxic myocarditis when present and a knowledge as an anesthetist that very high percentages of oxygen are required with either nitrous oxid or ether in a case of toxic myocarditis. A sphygmomanometer is essential in his equipment.

Third: He should at no time administer nitrous oxid-oxygen when pure oxygen direct to the patient's lungs is not available instantly.

Fourth: Until he is familiar with all the physical signs by which an anesthetized patient's condition is judged, namely pupil reactions, signs of the extrinsic muscles of the eyeball (Guedel) together with respiration, pulse and systolic and diastolic blood pressure observations, as well as color he will do much better to select ether rather than nitrous oxid as the agent of choice in deeply jaundiced persons and those of the dark skinned races.

CASE 3. (December, 1916). Mrs. H. D. Age 31, weight, 125 lbs., sick five days, pulse over 150 and arythmic three days previous. Diagnosis, pus tube ruptured or ruptured ectopic pregnancy. Patient suffering moderate air hunger for six to eight hours. Slight cardiac dilatation to right. Pulse 150, arythmic and irregular. Systolic blood pressure 118, diastolic 80. Pain in left chest radiating to center for past six to eight hours. It was later learned that a diagnosis of myocarditis had been made and ice bags ordered for chest three days previously by another physician and refused, as was operation at that time. Morphin sulphate gr. 1/8 and scopolamin gr. 1/150 were administered hypodermically and one-half hour later nitrous oxid-oxygen induction was begun, again with a small percentage of oxygen. Pupils dilated during first few breaths. Respiration stopped almost with dilatation and pulse last. Pure oxygen under pressure was not immediately available.

DEDUCTION—*First*: Weight was here placed on a nearly normal blood pressure reading without due concern for the other factors involved. A normal pulse pressure with a very rapid heart rate leaves no reserve of a possible increased rate when needed.

Second: As in Case 2 scant oxygen was administered in a case of toxic myocarditis when a large excess of oxygen was needed by the patient. Ether instead of nitrous oxid might have been wisely added to the oxygen.

Third: Again pure oxygen was not instantly available with which to inflate the lungs when normal respiration ceased.

CASE 4. (November, 1917). Baby, one year and ten months of age. Blue baby at birth, otherwise normal. No heart lesion demonstrable. Diagnosis, Naevus of the scalp. Anesthesia induced with nitrous oxid and oxygen and continued with ether and pure oxygen, using an adult mask and slightly negative pressure, requiring slight inspiratory effort to maintain flow of oxygen through ether. During fifteen minutes consumed by the operation, the pupils were normal but pulse gradually decreased in rate. At this time ether was shut off and pure oxygen continued, pulse rate still decreasing. Voluntary respiration stopped twenty-five minutes after anesthesia began and was continued artificially with pure oxygen under pressure. Heart stopped thirty-five minutes after anesthesia began.

DEDUCTIONS—*First*: The most likely explanation of anesthetic death in a child, over-dose of the drug, would seem to be ruled out by the contracted pupils. However, we know that a child's pupils often fail to contract after the second stage of anesthesia and remain dilated while in apparent perfect surgical anesthesia. Conversely, they possibly may fail to dilate when entering the fourth stage.

Second: Probably this baby was asked to make some effort at inspiration in order to keep up the flow of oxygen. Could this have been a factor? My present habit is to use some excess pressure,

that the inhalation may be free, when anesthetizing children with an apparatus of this sort.

Third: An adult mask with outlet valve in the top was used which may have been too large for the tidal air of the child patient, thus causing it to accumulate an extreme excess of carbon dioxid and not getting the fresh mixture at all. This case comes nearer convincing me that death can occur from the administration of an anesthetic *per se*, without the added factor of poor technic, than any other with which I am familiar. I am at a loss to explain the accident satisfactorily.

CASE 5. (November, 1918). J. R. Age 37, weight 145 lbs. Healthy male. Operation preparation of dental cavities. Patient extremely apprehensive and worried because of cavity preparations extending over previous days and refused to continue work without anesthesia.

Nitrous oxid and oxygen anesthesia was induced with ease; pulse, reflexes and color remaining excellent during fifteen minutes. More than ten per cent. oxygen was mixed with the nitrous oxid. The position used was a semi-reclining one in the chair. With the advent of signs of vomiting nitrous oxid was increased but vomiting occurred. Position of the chair was quickly changed to one in which the trunk is past a right angle with the thighs, and head forward, the color becoming increasingly cyanotic during this time and the pupils dilated. Respiratory efforts using accessory muscles of respiration were noticeable at this time. Semi-solid vomitus presented from the mouth. A finger in the mouth removed more stomach contents; the throat felt clear. However, attempt at inflation of lungs with pure oxygen through a face mask failed; another exploration of throat with curved forceps and finger removed a particle of meat from the glottis of a size to perfectly fit that cavity. Further inflation of lungs with pure oxygen was easy. The pulse at this time was rapid and weak. Artificial respiration with oxygen was continued over an hour without effect except that the cyanosis was replaced by pallor. This patient had eaten his noon-day lunch three and a half hours previous to the induction of anesthesia.

Autopsy showed a normal heart and other organs but lungs more or less completely contaminated by semi-liquid vomitus both in the bronchi and smaller divisions to the alveoli.

DEDUCTIONS—*First*: An individual, when under mental stress may have his digestive processes slowed to a considerable extent. I have since seen a patient with normal digestion who retained food eaten twenty-four hours previous to operation.

Second: The semi-reclining position, ordinarily desired for dental work, is a dangerous one in which to administer anesthesia. The possibility of inhaled vomitus and respiratory obstruction is a real danger. Safe positions during anesthesia are necessary even at the inconvenience of the operator.

CONCLUSIONS.

A. F. Stotts of Galesburg, Ill., speaking before the American Association of Railway Surgeons, October, 1911, said: "*The three most important factors concerned in anesthetic mortality rate, in their order of importance, would seem to be the anesthetist, the patient and the anesthetic agent; and we might also say that these same three factors in their order of enumeration are the most properly concerned in the safety of any anesthetic administration. By far the most important essential in the safety of the anesthetic is that it be administered by an expert.*" I think he is right.

I believe that the witnessing of these accidents has helped me to avoid similar ones since; and I hope by that much have I gained in my struggle to become an expert in the art of anesthesia. If, by reporting them in such detail as was possible, anyone can be helped along the road which I am traveling I shall be very happy. The time is approaching when more adequate instruction may be had in the science of anesthesia. In the meantime reports of our failures and accidents I believe worth while.

In conclusion an anesthetist must *first* be able to estimate himself, the strong and the weak points of his ability. He must not attempt the impossible. He must have the initiative to use his own judgment in preference to that of a specialist in another field.

Second, he must be able to estimate his patient, to recognize myocarditis and a weakened circulatory system and treat it as it deserves.

Third, he must have at his command a series or combination of drugs with which he is thoroughly familiar together with proper apparatus for getting them to his patient at the right time. This will include (a) a knowledge of the value of oxygen when added to all inhalation anesthetic agents and the mechanical means to properly administer it in proper dose at the proper time; (b) a knowledge that it is poor judgment to hurry nitrous oxid-oxygen induction at any time and especially so in a case of weakened circulatory muscle. Let him remember that such a patient has a tendency to dyspnoea in bed and will be comforted by pure oxygen and anesthetized while still taking high percentages of that gas; (3) a knowledge of the folly

of attempting muscular relaxation with nitrous oxid and oxygen alone without preoperative administrations of sedative and relaxing drugs or the addition of ether to his mixture; (d) and lastly, it will include a careful attention to preoperative preparation and position of his patient during operation if these factors are to add or subtract from the patient's risk.

525 FRANCES BUILDING.

ANESTHESIA IN WAR SURGERY

A MIXTURE OF ETHYL CHLORID, CHLOROFORM AND ETHER FOR GENERAL ANESTHESIA—AN EXPERIENCE IN WAR SURGERY.*

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The use of ethyl chlorid as a general anesthetic is given but four scant pages in a recent volume written by Flagg on "The Art of Anesthesia." He describes briefly the tecnic for giving ethyl chlorid as a sole agent for the induction and maintenance of general anesthesia, but it is evident that the main object of his description is to discourage its use because of its dangerous properties. He barely mentions certain "admirable properties as an adjuvant to chloroform and ether."

Having had no experience with ethyl chlorid alone for general anesthesia, the writer can not discuss that feature. However, it was his fortune to be stationed at an Evacuation Hospital (No. 114) in the Argonne during the last month of the war and to have occasion to employ at this hospital, for general anesthesia, ethyl chlorid in combination with chloroform and ether in a considerable number of cases.

The observations that were made in the use of this mixture, in the type of surgery which confronted the medical officer at the time, were very favorable. *It was uniformly declared to be the most suitable anesthetic for all minor injuries as well as for wounds of medium severity. It was adopted at this hospital as the anesthetic of choice for practically all operations which could be completed within 15 to 20 minutes. The speed of the operating team was therefore, in many instances, the criterion as to whether the choice should be the ethyl chlorid mixture, or simply ether.*

*Read before the Western Surgical Association, at Kansas City, Mo., December 19, 1919. Authorized by the Surgeon General of the Army.

DRAWBACKS OF OTHER ANESTHETICS IN WAR SURGERY.

Nitrous oxid anesthesia was not practical for at least three reasons. Nitrous oxid gas was not readily obtainable; the apparatuses were usually out of repair; and a sufficient number of skilled anesthetists were not available.

The usefulness of the ethyl chlorid mixture in war surgery was demonstrated by French surgeons

Fig. 1—The Mask and the Bottle of the Mixture.

in 1916. The use of this form of anesthetic was by no means universal in the French Army, but a certain number of their leading surgeons had become familiar with the method and employed it throughout the last year of the war. It was introduced into a few American hospitals near the end of the war. So far as the writer has been able to ascertain, it was given a more extensive trial at our Evacuation Hospital than at any other American hospital. It was adopted for the cases already indicated at the request of Commanding Officer, Lt.-Col. J. C. McCoy, who had acquired the technic from the French.

Although ether was used by the majority of the American surgical teams near the front, it was evident to all that it had several serious drawbacks, namely:

1. The time necessary to put the patient to sleep was often a total waste so far as the rest of the operating team was concerned. A quicker anesthetic would have enabled many surgeons to handle

at least twice as many cases as they did in a given time. This was exceedingly important in view of the necessity of early prophylactic excision of the wounds before infection could become established in the tissues.

2. Many wounded came to the operation soon after eating. Ether anesthesia would usually not be effective in such cases until the stomach had been evacuated by repeated emesis with its attendant danger of aspiration.

3. Many wounded were suffering from colds, tonsilitis, pharyngitis, laryngitis and bronchitis. It seemed doubly unfortunate to be obliged to administer ether to all such patients, especially as "the flu" infection was present at the time.

4. After a deep ether anesthesia, even of short duration, the patient required to be left in the hospital bed for a sufficient length of time to overcome the effect of the anesthetic. This was of importance to the incoming wounded who sometimes had to remain on the litters until those already operated could be evacuated from the hospital.

VARIOUS E-C-E MIXTURES AND METHOD OF ADMINISTRATION.

It was in respect to these objections that ethyl chlorid in combination with certain amounts of chloroform and ether, was found to have decided advantages over ether alone.

Different French surgeons employed slightly different proportions of ethyl chlorid, chloroform and ether. The mixture used by the writer was that recommended by M. Savariaud. It consists of ethyl chlorid 5 c.c.; chloroform 1 c.c. and ether 24 c.c., making a total of 30 c.c. for each anesthesia. It was given by the closed method of administration in a rubberized bag. M. Savariaud devised a mask for this purpose and Pellot and other surgeons made improvements on it to suit their fancies. We were unable to obtain any of these masks and were, therefore, obliged to improvise them out of materials at hand.

Our method of preparation and administration of the anesthetic was as follows:

A piece of very thin but strong rubberized linen is trimmed into an oblong or circular shape 55 c.m. long and 65 c.m. wide. This is hemmed or faced around the margin so as to permit the introduction of a puckering string by means of which the oblong material can be drawn into a bag, *i.e.*, into a mask to fit over the face. A hole is cut in the center of the cloth about 2 c.m. square. Two oblong pieces of cotton flannel are prepared, each large enough to cover the patient's face. The mixture is then prepared in an ordinary one ounce medicine bottle. A strip of adhesive plaster is fastened to the bottle and on it is marked the 5 c.c., 6 c.c. and 30 c.c. levels. Ethyl chlorid is put into the bottle from a tube up to the 5 c.c. mark, 1 c.c. chloroform is added, lastly ether is poured in up to the 30 c.c. mark and the liquid is thoroughly mixed.

METHOD OF ADMINISTRATION.

1. One of the two pieces of cotton flannel is laid dry over the patient's face and the other piece is placed in a cup or small pus basin.

2. The whole contents of the bottle is poured into the cup over the piece of flannel, which absorbs practically all the 30 c.c. mixture.

3. The piece of flannel is then rapidly picked up before evaporation takes place and spread out smoothly over the other piece on the patient's face. The patient must be told to hold his breath before the saturated cloth is approximated to the face and until the mask is properly adjusted.

4. The mask is placed over the face and the puckering string drawn tightly and tied so that the margin of the mask is held firmly around the face, under the chin, in front of the ears and over the top of the head. It is desirable that the mask be applied air-tight to the face, though practically this may be impossible, especially over the hairy part of the head.

As soon as the mask is applied the patient is directed to take short breaths. This will cause him to lose consciousness quickly from the ethyl chlorid vapor as being the most volatile of the drugs used. If he should give evidence of struggling with his respiration when he fills his lungs more completely a few moments later, he will, as a rule, have forgotten it when the operation is over. The jaw muscles will occasionally become firmly set and may interfere somewhat with respiration, at the beginning of the anesthesia and until the patient is fully asleep. To overcome this interference, some anesthetists adopted the method of placing a cork, securely fastened by a string, between the patient's teeth before the mask is applied.

Unconsciousness comes very rapidly. After six to ten deep inspirations the incision can be made. The closed mask causes a continuous re-breathing and the respiratory center shows a distinct stimulation throughout the time of anesthesia. The inflow of air through the small opening in the center of the mask may be regulated by the anesthetist's fingers.

The anesthesia from the dose given lasted from twelve to twenty minutes in the average wounded doughboy. In the experience of the writer, if a certain surgical procedure could not be completed

during this sleep, ether was added through the opening in the mask until the operation was finished. The French surgeons referred to did not hesitate to give a second dose of the same mixture when required. After the removal of the mask, the patient would wake up in a few moments. In the cases where the location and severity of the wound did not form a contra-indication, the patient would walk out of the operating room after five or ten minutes' rest on the table or on a chair.

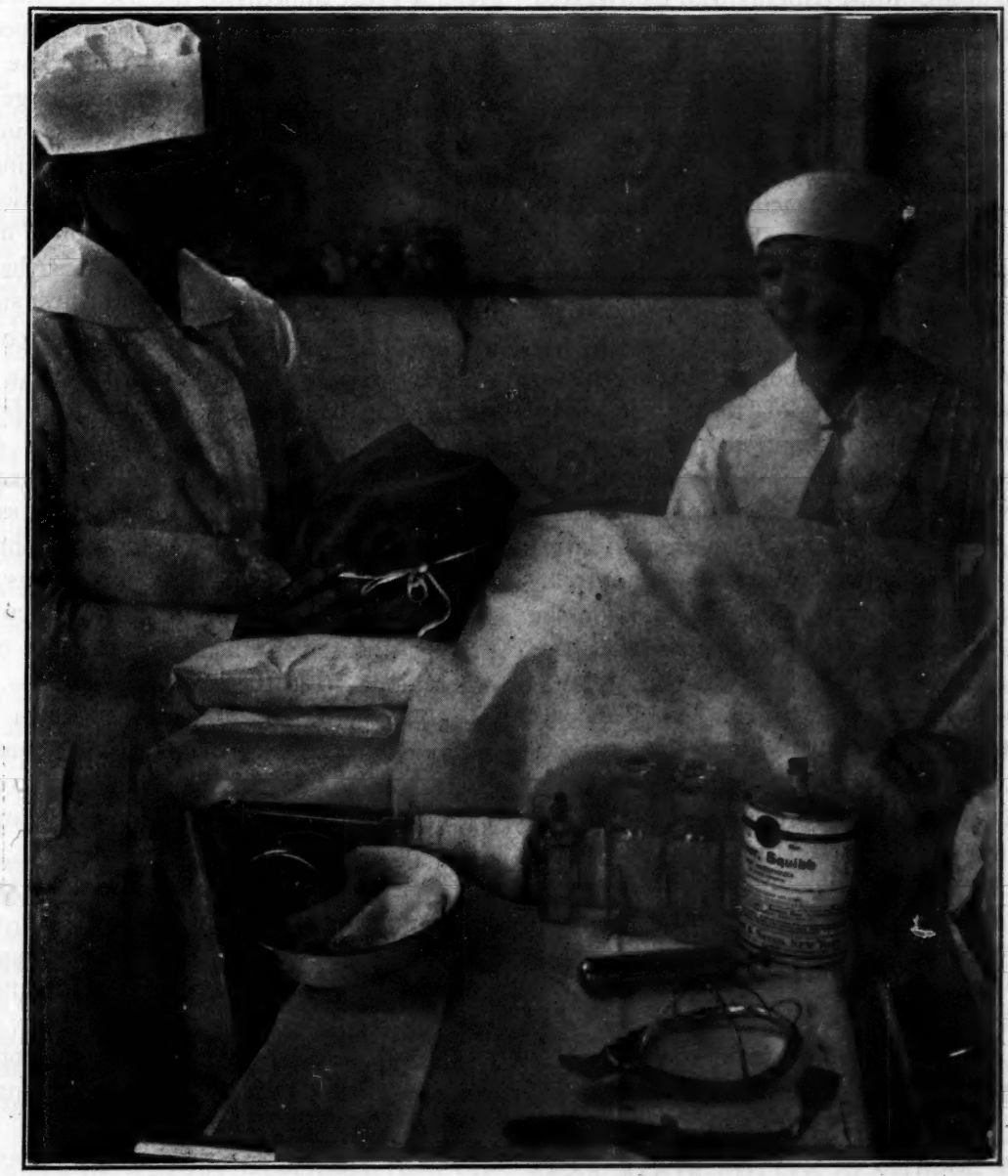

Fig. 2—The Mask Applied to the Patient.

REACTIONS OF PATIENTS.

The anesthesia was highly satisfactory in the kind of work in which we were engaged. The fact that the patient was ready for incision within one minute after the application of the anesthetic, made it possible for the surgeon to work practically without intermission. After the completion of one operation, the anesthetist stepped to the next table where another patient was already waiting to be anesthetized. By the time the surgeon and his assistant had changed gloves, the anesthetist had prepared the mixture and was ready to apply the mask.

The patient would not always be completely relaxed. There would be, in some cases, slight involuntary muscular movements or quivering, throughout the operation, but not enough to interfere seriously with the work. These spasmodic movements when present would be as marked in other parts of the body as in the part operated on, which tended to show that they were not due to painful impressions from the site of the trauma, but rather to the stimulating influence of the anesthetic. In some patients a short period of excitement was present after the first inspiration, and

with others there would be a few minutes' exhilaration after the mask was removed.

There was practically no stimulation of mucus in the throat, a very desirable condition in those suffering from laryngal or bronchial infection, and the proportion of these was very high. Nausea was evident in only a few and emesis took place while the patient was waking up in the few cases where it was present at all. Most patients who had walked to the operating table could and did walk away from it after a ten or fifteen minutes' operation.

RESULTS.

We had no death from the anesthetic, no syncope, no alarming cyanosis and no serious difficulty with respiration. Being in an evacuation hospital, it was, of course, not possible to observe the patients more than a few hours after operation, but from such information as could be obtained, the after-results were satisfactory.

There were 400 patients operated in all under this anesthesia, the majority of these being performed by the writer. The nature of the operations ranged from small excisions of superficial wounds to the removal of extensive lacerations, including amputations of arms and legs. Intra-cranial, intra-thoracic and intra-abdominal injuries were not treated under this form of anesthesia. Wounds on the face would, of course, exclude the use of this method.

There can be no reason why this ethyl chlorid mixture should not be used in emergency surgery in civil practice when conditions and necessities correspond more or less to those of the wounded soldiers. The lessons learned from acute war surgery which are of practical importance for civil practice are not many when we consider the great amount of surgery done at or near the front. The use of ethyl chlorid as indicated above, is, in the opinion of the writer, one of these lessons.

IN BEHALF OF THE ADVANCEMENT OF YOUR SPECIALTY YOU ARE REQUESTED TO READ A PAPER ON SOME PHASE OF ANESTHESIA BEFORE YOUR LOCAL, COUNTY OR STATE ASSOCIATION. IT IS ALSO UP TO YOU TO PREPARE YOURSELF TO TEACH ANESTHESIA IN YOUR MEDICAL SCHOOL AND TO INSTRUCT INTERNS IN THE HOSPITALS IN WHICH YOU WORK. THE AMERICAN ANESTHETISTS ARE MAKING AN EFFORT TO SECURE A SECTION ON ANESTHESIA IN THE AMERICAN MEDICAL ASSOCIATION. USE YOUR INFLUENCE AS WELL AS THAT OF YOUR FRIENDS TO GET YOUR STATE SOCIETY BEHIND THIS VITAL AND NECESSARY MOVEMENT TO INCREASE THE SAFETY OF ANESTHESIA, TO HAVE IT MEET THE PROGRESS IN SURGERY AND THE EXTENDED DEMANDS OF HOSPITAL SERVICE.

A MODIFICATION OF THE OPEN ETHER METHOD.

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The particular requirements of war surgery have given a great impetus to the use of ether as a general anesthetic for routine work, and especially to its administration by the open method. The preference shown for this method is, perhaps, largely because, on paper at any rate, it seems to be so simple and so devoid of difficulty and danger. Omitting the question of safety, it will be found in practice, especially by the beginner, or if the attempt be made to use ether alone from start to finish, that the method is not so simple and easy as might at first sight appear.

DIFFICULTIES OF OPEN ETHER ALONE.

In the course of the last three and a half years or more, as I reported in the British *Medical Journal*, May 24, 1919, I must have paid close upon 1,000 visits to different war hospitals throughout the country, and so have enjoyed exceptional opportunities of watching the work and obtaining the views of other anesthetists. From this experience I gather that the chief practical difficulties which present themselves when the attempt is made to use ether alone from the beginning are:

1. The period of induction is much prolonged. As much as twenty minutes has frequently been reported to me, and in some cases I have been informed that it had been absolutely impossible to get the patient under at all,

2. Nearly all patients object to the taste and smell of *straight* ether, and in those of the over-robust type and in the alcoholic this objection is frequently the prelude to respiratory spasm, lividity, and troublesome struggling.

3. In the same type of patient, too, complete muscular relaxation appears to be difficult or impossible of attainment.

4. The amount of ether used is often excessive. From 12 to 16 oz. an hour is no uncommon record, and I have known it to be even more. This, of course, is a trouble which makes itself felt by every occupant of the operating theatre.

5. The flow of mucus and saliva may be excessive and when this is the case the patient is very apt to develop an undue amount of postoperative bronchial irritation.

UNTOWARD EFFECTS OF INDUCTION WITH CHLOROFORM OR STRONG C-E MIXTURES.

Continuous practice will, of course, go a long

way towards mitigating these troubles. The prior injection of morphin and atropin, especially the latter in tolerably large doses, is also a great help, particularly with regard to the excessive salivation and tendency to bronchial irritation.

Usually, however, the anesthetist seeks to overcome the difficulties by starting with a little chloroform or *mixture* (equal parts of chloroform and ether, or 1 of choroform to 2 of ether, or 2 to 3). This is generally administered upon the same mask as prepared for the ether alone—that is, twelve to sixteen layers of gauze with an underlying face-pad, and the patient is carried to the stage of complete anesthesia, and the pure ether is substituted as soon as it is thought that he will no longer resent the change. *In many, perhaps in the majority of instances, this plan succeeds well enough for all practical purposes, but in rather a large number of cases a tendency to respiratory cardiac failure develops in the course of two or three minutes after the change to pure ether has been made. I believe myself, too, that in some cases deaths have resulted in this way.*

To explain these untoward results, it has been suggested that the face-pad and thickish layer of gauze or lint used in the open ether process do not permit of a sufficient dilution of the vapor with air, as is so essential for the safe administration of chloroform, and that when the gauze is wetted, particularly with the heavy, semi-viscid chloroform liquid, an almost impervious or closed system is formed, with momentary accumulations of dense chloroform vapor immediately above the mouth. At any rate, it is quite clear that if chloroform or one of the strong mixtures be used for induction, the face-pad should be discarded, an entirely separate and much thinner mask employed, and the patient must be most carefully watched for the faintest indication of respiratory or other failure. Slight as these changes really are, they suffice to rob the open ether process of its simplicity, and therefore are seldom adopted.

MODIFIED OPEN ETHER.

Looking about for a means to overcome these difficulties, my attention was attracted by Dr. McCardie's excellent paper on "A Method of Anesthetizing Soldiers," which appeared in the *British Medical Journal* of April 21st, 1917, in which he advocated the use, in a Clover's inhaler, of a mixture of 1 part of chloroform to 16 of ether. I proposed, thereore, to use this combination of 1 to 16 in lieu of the stronger mixtures alluded to above. Before doing so, however, I took the opportunity when in Birmingham to discuss the subject with Dr. McCardie. He expressed his doubts about my proposal, and said that he thought the same objections would apply to his 1 in 16 mixtures as to the stronger ones. However, I gave the combination a trial, and, although it succeeded admirably in many cases, it obviously required careful watching, and in some few instances I received rather adverse reports about it.

I then experimented with various combinations of the two drugs, and have finally settled upon a mixture of the following proportions:

Chloroform ..... 1 drachm
Ether .....32 drachms (4 oz.)

This, it will be seen, is approximately 3 per cent. of chloroform in ether, or a very little stronger (3 in 99).

In using this attenuated mixture I have found that the following are the chief points to be attended to. Although not essential, it is of advantage that the patient should have a preliminary injection of morphin (1/6 grain to ¼ grain) and atropin (1/100 grain to 1/60 grain). The face-pad and mask is the same as for open ether, the mask being closely applied to the face and face-pad from the very beginning. The liquid is used exactly as if it consisted of ether alone, the presence of the small quantity of chloroform being ignored. During induction the liquid is poured freely on to the mask just to the verge of resentment, but when consciousness and reflexes are abolished, it will suffice to reduce the supply to the dropping stage. If at any time during the course of the operation it be thought that the anesthesia is not sufficiently deep, there need be no hesitation about increasing the amount. Needless to say, the same care in watching and maintaining the breathing are required in this as in any other method of anesthetization; the plan makes no pretence to be absolutely fool-proof.

ADVANTAGES.

In my own hands and in the hands of many others who have tried it, the combination used in the way indicated has given excellent results. The advantages that I would claim for it are:

1. *Simplicity.*—There is no need to change the drop bottle or mask, or to remove the face-pad which are the same as for the original open ether method.

2. *Rapidity.*—As the result of many careful time tests I have found that the patient is well able to be moved in about five minutes, and that the first incision may be made in another minute or so. At the outside, ten minutes should complete the whole process. This is a very great gain as compared with a possible twenty minutes—a gain both to the patient and the temper of the surgeon.

3. *Lack of Irritation.*—It is really quite remarkable how the addition of such a small quantity of chloroform should go so far in the direction of converting the pungent ether into a comparatively bland vapour. The consequence is that the patient has much less objection to the inhalation than when pure ether is used; there is also less respiratory spasm, less lividity, and the struggling is practically limited to the simple movements of the stage of excitement.

4. *Efficiency.*—This, of course, is a point upon which longer experience is desirable, but so far I have never had any difficulty in obtaining a sufficient degree of relaxation to satisfy the requirements of any of the surgeons with whom I have worked, and the depth of anesthesia can be very readily regulated.

5. *Economy.*—The greatest expenditure of the liquid is naturally during the induction stage, but that seldom exceeds a couple of ounces, and I have estimated that for the maintenance of anesthesia subsequently from 4 to 6 oz. per hour is ample. This is a very great saving and comfort to all concerned.

6. *Safety.*—Neither this nor any other anesthetic can claim to be absolutely safe, nor can it be said that care and attention on the part of the administrator are less valuable assets than with any other drug or combination. On the face of it, however, I think that it is obvious that the possibilities of over dosage with chloroform are much diminished when the half-drachm required for induction is diluted in two ounces of ether, given in ten rather than in two minutes, and that a drachm to a drachm and a half used in the course of an hour is but little likely to do much harm.

The flow of mucus and saliva and the subsequent tendency to respiratory irritation are much diminished, but I do not claim that this is to be wholly placed to the credit of the mixture, but rather to the routine use of full doses of atropin which I have always advised. I should point out, however, that on account of its relative rapidity of action the 3 per cent. mixture will be found useful to those who adopt the open ethyl chlorid-ether sequence. In fact, I have myself made a few quite satisfactory experiments in the direction of using liquid ethyl chlorid in lieu of chloroform, but I have not followed up this line of work, although I believe that it may be worth while doing so. One of the objects of this communication is to establish the principle of what I would call *attenuated mixtures,* and to endeavor to show that *straight* chloroform or strong mixtures are by no means essential as an induction to open ether, but that, on the contrary, they introduce unnecessary risks in the open ether method.

16 NOTTINGHAM PLACE, W.

ANESTHETICS IN A BRITISH HOSPITAL WITH THE SERBIAN ARMY.

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This series of anesthetics, originally reported in the *British Medical Journal,* May 31, 1919, was commenced in August, 1916, and continued until January, 1918. All the operations took place under canvas in the heart of a country with a subtropical climate. The nationality of the subjects treated was mainly Serbian. The Serbian soldiers were very fit and strong men between the ages of 18 and 50, most of whom had faced the hardship of war, not only during the present struggle, but in the previous Balkan campaigns and practically all had led an outdoor life. The outstanding features from an anesthetist's point of view were their good physic, the sound state of their teeth and the absence of dentures; a large percentage did not smoke at all, and those that did were almost cigarette smokers. *A noticeable feature in the early stages was the fear of an anesthetic. Special account had to be taken of endemic disease (malaria), and occasionally of the effects of dysentery and scurvy in their relation to cardiac complications.*

In the first series many of the wounded were in a state of exhaustion on admission, owing to difficulties of transport. Where possible, these cases were allowed to rest for some hours before operation.

METHODS OF ANESTHESIA USED.

The methods of administration adopted were as follows:

1. Open administration of a mixture (ether 2 parts, chloroform 1 part), with and without previous administration of morphin.
2. McCardie's mitigated ether method with open E_2C_1 sequence (with and without previous administration of morphin and atropin).
3. Closed ether, sometimes with oxyyen.
4. Nitrous oxid.
5. Nitrous oxid-ether sequence.
6. Nitrous oxid with oxygen (improvised).
7. Chloroform (Junker's bottle).
8. Combination of methods 1, 2, 3, and 6 with local anesthesia.

Methods 1 and 2 were the most frequently employed; they were given in a series of cases, with and without previous alkaloidal administration, and the results were compared. The cases which had not had a previous injection of alkaloids were in general head cases and thoracic injuries. The administration of E_2C_1 mixture was sometimes pre-

ceded by ½ to 1 drachm of chloroform given drop by drop on a Schimmelbusch frame covered with 12-ply gauze and a layer of lint (with a small hole the size of half a crown in the centre) over all. In this method the morphin when given was in doses of 1/6 or ¼ grain one hour to one hour and a half before operation, as nearly as it could be gauged. At this stage no atropin was given.

The anesthesia obtained was as a whole very satisfactory. Induction was rather slow (about six to eight minutes on the average), *and in cases newly admitted from the trenches it was often accompanied by great excitement and struggling, whether morphin had been given or not.* The maintenance of anesthesia was as a rule even and regular; there was little vomiting, and no respiratory disturbance or salivation. *It was noted that those patients who had morphin took a little less anesthetic, and generally the induction was quieter and a little quicker. Signs of stock on the table were absent, except in a few cases where the operation had been prolonged and severe, or where hemorrhage had occurred.* The period of recovery was quiescent.

1. E_2C_1—SCHIMMELBUSCH FRAME.

The following summary shows the quantities of anesthetic used:

(*a*) With preliminary morphin: 333 operations; average length of operation 37.9 minutes; average quantity per operation 11.3 drachms; or, taking an operation of thirty minutes' duration, 8.7 drachms.

(*b*) Without preliminary morphin: 231 operations; average length of operation, 33.1 minutes; average quantity per operation 10.6 drachms; or, taking an operation of thirty minutes' duration, 9.6 drachms.

It will be noted that there is not a big difference in the quantities used in the two classes, the cause being chiefly absence of the ideal conditions for complete success with preliminary alkaloids, such as quietness of surroundings, subdued light, and smooth transport from ward tents to theatre. However, the other benefits were obtained. With regard to the quantities used as compared with open ether administration, the figures given by Silk and others are 6 to 8 ounces an hour, or even 8 to 10 ounces an hour in Malta.

2. M'CARDIE'S MITIGATED ETHER.

In this procedure a Clover apparatus is used into which 1 oz. of ether, with half a drachm of chloroform, are placed in the container, and 21 minims of E_2C_1 mixture in the bag. The facepiece is closely and firmly applied; induction is commenced by rebreathing from the bag only for forty to sixty seconds, and followed by turning on the mitigated ether. Watch is kept for cyanosis, and if this appears (which is rare), one or two breaths of air are given. Induction was almost always easy, quiet, and rapid, taking four or five minutes. Anesthesia with these quantities lasted from fourteen to twenty minutes, when, if the operation required it, open E_2C_1 followed. Those cases which had a previous alkaloidal administration were given morphin gr. ¼ and atropin gr. 1/150, half an hour before operation as nearly as possible.

The advantages gained from this method were confirmatory of those claimed by McCardie,[2] namely—

1. The respiratory irritation due to ether vapor by the closed method is much mitigated by the addition of a small quantity of chloroform.

2. The addition of chloroform in this amount distinctly saves the work of the heart and lungs in a long or severe operation.

3. The mixture is practically as safe as ether alone.

4. It is valuable as a routine method of inducing anesthesia, being safe and rapid.

5. A few drops of E_2C_1 mixture are preferable to ethyl chlorid as a preliminary to the administration of the mitigated ether.

6. For maintenance of anesthesia E_2C_1 mixture by the open method is preferable to even mitigated ether, owing to the prevalence of respiratory irritability in soldiers.

The following summary shows the total quantities of anesthetic used with and without previous alkaloids:

(*a*) With alkaloids: 214 operations; average length of operation, 30.1 minutes; average quantity used, 13.2 drachms; or, for operation of 30 minutes, 13.12 drachms.

(*b*) Without alkaloids: 100 operations; average length of operation, 29.06 minutes; average quantity used, 14.4 drachms; or, for operation of 30 minutes, 17.7 drachms (that is, including the original 1 ounce of ether and half a drachm of chloroform put into the Clover inhaler).

3. CLOSED ETHER.

This was only used in 65 cases, 26 with previous alkaloidal treatment and 39 without.

(*a*) With alkaloids: 26 operations; average length of operation, 42.03 minutes; average quantity used, 17.8 drachms; or, reduced down to an operation of 30 minutes, 12.6 drachms.

(*b*) Without alkaloids: 39 operations; average length of operation, 35.1 minutes; average quantity

used, 16.1 drachms; or, reduced down to an operation of 30 minutes, 13.6 drachms.

This method was adopted in several cases of a severe type, such as high amputations, and also in slight cases. In the first it was often accompanied by oxygen and occasionally warmed by placing a little hot water in the bag, as recommended by Beresford Kingsford. I abandoned it for general use on account of various well known disadvantages, such as respiratory discomfort, salivation (particularly prevalent in Serbs), and also the objection by some patients to a closed apparatus. The addition of oxygen helped materially in lessening the amount given, and easing induction.

4. NITROUS OXID.

This was given frequently for minor operations in 111 cases, including some dental ones. The apparatus in use was of the simple ordinary variety, with an arrangement for rebreathing. It was found very efficient, especially if given by the rebreathing method with intervals of air breathing according to stage of narcosis, the aim always being to avoid any cyanosis. The use of a rubber dental prop, as Boyle suggests, is a great advantage; it aids induction and ensures easy ingress for the gas or air, especially if there is the slightest sign of nasal obstruction.

5. NITROUS OXID-ETHER SEQUENCE.

This was adopted in some forty-five cases, and gave very satisfactory results. The type of case generally chosen was the minor or short operation, and in which there had been no antecedent alkaloidal preparation. Here again the rubber dental mouth prop is advantageous.

6. NITROUS OXID WITH OXYGEN.

This was employed only twice, in an improvised fashion, owing to the lack of any suitable apparatus, such as that recommended by Captain A. S. Wilson. Rough and ready as the method was, it proved of great value in two cases of amputation of the thigh, in which the patients were very weak from chronic sepsis. In both novocain was injected at the site of amputation, and in one ¼ grain of morphin was given one and a half hours before. The operations were performed quickly, there were no signs of shock, and recovery from anesthesia was rapid and without any incident, such as vomiting.

7. CHLOROFORM.

This was only used in operations on the face and lower jaw by means of a Junker's bottle. The proportion of these cases was not large, and no special difficulties were met with. The chloroform was introduced by means of a soft rubber catheter passed five inches down the nose.

8. LOCAL ANESTHESIA.

This was frequently used alone or in conjunction with a general anesthetic in operations on the head and chest, and for amputations. It certainly aided in diminishing the amount of anesthetic used, and in limiting shock or disturbance during section of nerve trunks. In thoracic operations the method is of great value.

GENERAL REMARKS.

By the use of alkaloids liability to shock on the table is decidedly diminished, and the amount of anesthetic required is less. The period of recovery is of a more quiescent character. It is contraindicated in cranial cases, especially where mentality is impaired, and in the recently severely wounded who are already suffering from shock. Care should be taken when any heart muscle weakness exists or is suspected from such causes as malaria or chronic sepsis.

The choice of anesthetic should be based on such considerations as the following:

1. Whether the wound is of a severe character and accompanied by shock.

2. The period of time that has elapsed since its infliction.

3. Whether hemorrhage has occurred or is likely to occur.

4. Whether an acute infection is present (notably gas infections) and the operation is likely to be of the nature of an amputation.

It is in the last named cases that the greatest dangers are likely to be met, but these are considerably diminished if the patient can have some hours' rest in bed with the application of external warmth. In such cases the best results have been obtained with an induction by McCardie's method, or warmed ether, and oxygen.

In abdominal cases McCardie's method was used with advantage, followed by ordinary closed ether and oxygen, if necessary. The use of oxygen is insisted on, as it acts as a stimulant, improving the anesthesia and diminishing the amount of anesthetics used.

I am specially in agreement with Captain Geoffrey Marshall's remarks on the choice of gas and oxygen in wounds of the limbs requiring amputation, and the withholding of morphin. His recommendation of it for smaller operations as a routine method is very timely.

For the average type of case which has been in hospital a little time and for operations of expediency the best results have been obtained by Mc-

Cardie's method, and, secondly, by the open administration of E_2C_1 mixture. These have the advantage of simplicity, ease, quietness of induction, and economy.

AFTER-RESULTS.

In some cases in which hemorrhage had occurred the use of E_2C_1 mixture was followed by collapse, which caused anxiety and necessitated the administration of intravenous saline.

Vomiting did not often occur during the course of operation, but chiefly when the patient was moved, in the application of dressings or transference to a stretcher. In the wards it occurred very seldom. There were no cases of delayed chloroform poisoning.

Chest complications were very few in number—not more than four or five in all (two of bronchopneumonia of a mild type, and the rest bronchitis). All recovered.

There were no fatalities.

I have to thank the operating surgeons, Major G. P. Mills and Lieutenant John H. Watson, for their constant help and suggestions, and the other members of the unit with whom I was associated in the work.

DURING SEVERAL RECENT MEETINGS OF THE GOVERNORS OF THE NATIONAL ANESTHESIA RESEARCH SOCIETY MANY PHASES OF A CONSTRUCTIVE CAMPAIGN FOR THE ADVANCEMENT OF ANESTHESIA WERE INITIATED. A SURVEY TO DETERMINE THE STATUS OF ANESTHETIC PRACTICE, EQUIPMENT AND METHODS IN THE HOSPITALS OF THE COUNTRY IS BEING MADE. ALSO A QUESTIONNAIRE IS BEING SENT TO ALL THE MEDICAL AND DENTAL SCHOOLS AND TEACHING HOSPITALS TO DETERMINE THE STATUS OF INSTRUCTION IN ANESTHESIA. THIS QUESTIONNAIRE IS BEING ACCOMPANIED BY A COPY OF THE YEAR-BOOK AS AN EVIDENCE OF THE PURPOSES OF THE ORGANIZATION AND THE TYPE OF WORK WHICH THE RESEARCH COMMITTEE IS ATTEMPTING.

THE FIRST OF A SERIES OF MONOGRAPHS ON ANESTHESIA IN THE SPECIALTIES IS NOW UNDER WAY AND RAPIDLY REACHING COMPLETION. IT IS BEING PREPARED BY A PUBLICATION COMMITTEE OF EXPERTS, OBSTETRICIANS AND ANESTHETISTS.

THE UNIFORM ANESTHESIA CHART HAS VIRTUALLY BEEN DECIDED ON AND WILL SHORTLY BE READY FOR DISTRIBUTION. IT IS TO BE HOPED THAT A GREAT MANY ANESTHETISTS AND HOSPITALS WILL USE THIS UNIFORM ANESTHESIA CHART ROUTINELY SO THAT MANY LESSONS MAY BE LEARNED FROM THE ACCUMULATED RECORDS.

TO STIMULATE INTEREST IN RESEARCH THE N. A. R. S. WILL AWARD MONEY PRIZES FOR THE THREE BEST PAPERS ON RESEARCHES IN ANESTHESIA PRESENTED DURING THE PITTSBURGH MEETING.

STOVAIN SPINAL ANALGESIA.*

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Since the year 1908, stovain spinal analgesia has been in use in the Montreal General Hospital with such uniformly satisfactory results, that inasmuch as spinal analgesia has ceased to be an anesthetic curiosity, I desire to add a word to further its use in selected cases for the benefit of mankind.

HISTORICAL EVOLUTION.

Surgery and anesthesia owe a debt of gratitude to the chemists and experimental pharmacologists, who discovered the active principle and analgesic property of the coca plant. Cocain then became a local therapeutic agent with an action on sensory nerve ending of producing insensibility to pain, or analgesia.

Bier introduced the spinal puncture in 1898 with cocain, injecting the solution into the subarachnoid space. He obtained complete analgesia in every case, pertaining to the lower half of the body, although in one patient the analgesia extended as high as the scalp. The by-effects were most disturbing, assuming the form of marked giddiness, severe headache, syncope and vomiting. Bier thought these unpleasant symptoms to be due to the loss of cerebro-spinal fluid. So he tried rest in bed as a preventive, but no beneficial result arising, he decided to drop the procedure as too dangerous and await the discovery of a less toxic drug.

In 1891, Giesel isolated the alkaloid tropacocain, which was found to be half as toxic as cocain and less poisonous in its action on the motor cells in the anterior horns of the spinal cord. Tropacocain has since been much in use in Germany.

In Great Britain and France stovain became much in favor after 1904, when its discovery was made by Fourneau and the pharmacological action by Pouchet, adding a third drug to the list of spinal analgesia agents.

Barker was a great pioneer in England in spinal analgesia, bringing the subject prominently to the notice of the profession, as well as advancing our knowledge of its technic. Barker used a compound solution, composed of stovain 5 parts, glucose 5 parts and distilled water 90 parts, all by weight. His solution having a specific gravity of 1.023 as against that of the cerebro-spinal fluid, which is 1.007, sinks to the lowest level of the patient's spine by gravitation.

*Read before the American Association of Anesthetists, during the Seventh Annual Meeting, Hotel Breakers Atlantic City, June 9-10, 1919.

PROPERTIES OF STOVAIN.

The properties of stovain as shown by experimentation are:

1. An analgesic action equal to cocain without concurrent vaso-constriction.
2. A cardio-tonic action.
3. A bacteriacidal action.

We prepare our own solution using stovain 5 gms., commercial glucose 5 gms., in 95 ccm. of physiological saline. This solution has a specific gravity of 1.031, a neutral reaction and is placed in glass ampoules of 2 ccm. capacity.

DOSAGE.

The dosage is regulated in accordance with the weight, age and vitality of the patient. The maximum dose of stovain is .07 gms. or 1.4 ccm. of solution and the minimum dose is .01 gms.

TECHNIC OF ADMINISTRATION.

The anesthetist washes his hands with surgical care for 5 minutes under running water, using soap and nail brush, and rinses them in alcohol. The patient's back is washed with alcohol over the sight of puncture and the iliac crests. The point of puncture is the 3rd lumbar interspace, which is readily found by noting the iliac crests, which lie at the level of the 4th lumbar spine.

A Record syringe of slightly more than 2 ccm. capacity, a spinal needle (Barker model), with stilette and cannula, ampoule and file are received in a basin in lysol-alcohol, 1 part in 12, and transferred to sterile water. The syringe, needle, stilette and canula are washed and rinsed in the water and the ampoule is broken. The canula is attached to the syringe and the ampoule emptied, and the air forced out of the syringe leaving the required amount of solution and the syringe and cannula are laid carefully across the water basin.

With the stilette in the needle in the right hand the left thumb finds the 3rd lumbar interspace and a point is selected ¼ of an inch from the midline, the needle is passed in forwards and slightly upwards, until the dura is pierced with the feeling of a sudden loss of resistence. The stilette is removed and the cerebro-spinal fluid is allowed to flow. One to two drachms of fluid will escape until the cannula has been inserted and the stovain solution is gently forced into the canal.

If marked resistance to the flow is encountered the needle should be withdrawn slightly when the flow will be more free. A very important factor in insuring a successful analgesia is the position of the patient for the puncture and following the injection. The saline menstrum tends to neutralize the osmosis factor and the glucose exerts a cohesive action to counter-balance the diffusible tendency, so the high specific gravity will carry the solution to the lowest dependent area of the cord.

CONTROLLING THE EXTENSION OF ANALGESIA.

So if the operation requires only the anesthetization of the sacral roots of the cord, that is for anal and perineal operations, such as hemorrhoids, fissure in ano, ischio-rectal abscess, etc., the sitting posture is used for the injection. The patient sits on the side of the table with feet resting on a chair, head and shoulders bent forward with the arms crossed, and afterwards is turned on to his back, having his head and shoulders raised to an angle of 45 degrees from the horizontal by means of an adjustable table, back-rest or pillows.

However, if the lumbar or lower dorsal nerves are to be controlled for lower extremity or abdominal operation, the patient with the head and shoulders raised, lies in a right lateral position for a right-sided operation or vice-versa, and the injection is made in this position. The patient is immediately turned on to his back and the hips are elevated by means of bar on the table. In this way the elevation of the hips and shoulders causes the dorso-lumbar area to be most dependent and the convexity of the back can be altered by raising or lowering the hips. After one minute has elapsed, sensation is tested by means of a sharp needle and the solution is allowed to flow upwards to the limit required.

For operations below the level of the umbilicus, analgesia is checked when the ziphoid sternum is reached by quickly lowering the hips to the level of the table and the analgesia ceases to advance.

If the abdominal operation is above this level, analgesia is allowed to ascend to the level of the 4th intercostal space anteriorily.

PRECAUTIONS.

It is most important that the elevation of head and shoulders be continuously maintained from the time of injection until 6 hours have elapsed from the time the patient leaves the operating room.

Since this has been an established rule, we have noted the absence of shock, faintness, cessation of respiration, or shallow respiration or symptoms indicating depression of the vital centers in the medulla oblongata.

Care must be exercised to prevent the head and shoulders at any time from being so low as to allow the stovain to gravitate upward beyond the dorsal cord, producing complete intercostal paralysis, with diaphragmatic breathing of diminished rate and depth. The pulse and respiratory rate are uniformly unaffected, and if pallor occurs it is

usually emotional, requiring reassuring words, bathing the face with cold water or administering a whiff of smelling salts.

PECULIAR ADVANTAGES.

This method of anesthetizing patients has been found to be most advantageous and is always used when possible in diabetics, advanced cardiac, pulmonary or real insufficiency and it eliminates the danger of postoperative acidosis.

Analgesia persists for a period of 45 minutes to 2 hours and stovain has been detected in the spinal fluid 24 hours after injection and traces have been found in the urine 74 hours after injection.

1363 GREEN AVE., WEST MOUNT.

EXPERIMENTAL STUDIES ON THE EFFECT OF ANESTHETICS IN SHOCK*

McKEEN CATTELL.
BOSTON, MASS.

The fact long known that patients in a condition of shock take anesthetics badly, was strongly brought to the attention of the surgeon during the recent war and led to an experimental study of the problem at the Surgical Research Laboratory at Dijon, France, which is now being continued in the Harvard Physiological Laboratory.

In the limited time at my disposal it is possible to give only brief summaries of the more important results, the details of which will be published later. The work has extended over a period of nearly two years and represents the results of experiments on over 150 animals.

EFFECTS OF ETHER IN SHOCK, SEVERE OPERATION, HEMORRHAGE AND ACIDOSIS.

It was found that in cats and dogs in a state of shock the blood pressure is very markedly influenced by ether, the inhalation of an amount just sufficient to cause the disappearance of the eye reflex usually resulting in a drop of pressure of over 50 mm. of Hg. The blood pressure of a normal animal in unaffected by this amount of ether, or only momentarily at the beginning of its administration. This condition of ether sensitiveness is gradually developed under any circumstances that depress the general bodily condition of the animal, especially low blood pressure. Severe operation, hemorrhage and the injection of acid into the circulation all cause a marked increase in the ether effect. Experimentally the condition was usually brought about by the reduction of the arterial pressure by compression of the heart. Holding the pressure down to 60 mm. for one hour was usually sufficient to produce this sensitiveness, which persisted after the return of the arterial pressure to its normal level.

COMPARATIVE EFFECTS OF NITROUS OXID-OXYGEN ANESTHESIA.

In this condition a comparison of the effects of nitrous oxid and oxygen and ether shows an interesting difference. Ether caused the usual marked fall in blood pressure, while nitrous oxid and oxygen given to the same depth of anesthesia may cause no fall whatever. In making these comparisons the anesthetics were usually administered in an amount just sufficient to cause a disappearance of the eye reflex, the procedure being identical in each case. With a relatively large proportion of nitrous oxid the fall may be nearly as great as with ether, but by using a concentration no stronger than necessary to produce the desired anesthesia (from 3 to 4 parts of nitrous oxid to 1 of oxygen) there is no effect on the blood pressure. This is confirmatory of a large body of clinical evidence. It is generally recognized by anesthetists that a patient in poor condition survives an operation in a much better state with nitrous oxid and oxygen than with ether or chloroform, and in the recent war every effort was made to have nitrous oxid and oxygen as widely available as possible for use on cases of shock and hemorrhage.

THE CAUSE OF INCREASED SENSITIVENESS OF BLOOD PRESSURE TO ETHER ANESTHESIA.

Experiments are now in progress regarding the cause of the increased sensitiveness of the blood pressure in shock to ether anesthesia, and a few statements may be made at this time. An examination of blood pressure records shows that even in a normal, unshocked animal the first effect of ether, in high concentration in the inspired air, is a rapid fall in the blood pressure, but this is quite temporary, the low pressure being followed by a rise to the normal level while the ether is still being administered. If continued to an extreme degree, the pressure again falls, this time to zero, resulting in the death of the animal. *In the shocked animal the effect is quite different; a similar fall in pressure occurs at the beginning but is not followed by a rise. Instead, there is a further fall which rapidly approaches zero even before the eye reflex disappears.*

An attempt has been made to determine the cause of the difference in reaction between the normal and the shocked animal by a study of the effects of ether on the heart and blood vessels. There is much evidence in the literature that the

*Read during the Eighth Annual Meeting of the American Association of Anesthetists, Hotel Grunewald, New Orleans, April 26-27, 1920. From the Department of Physiology, Harvard Medical School.

peripheral action of ether is mainly on the heart, and that the resulting depression is sufficient to account for the fall in blood pressure which may result. This is confirmed by a series of experiments carried out on cats. *Measurements of the heart volume show that from the very beginning of the administration of ether there is a loss of tone, which becomes greater as the anesthesia deepens and reaches a maximum only with the death of the animal. Studies on the isolated auricle from the turtle heart show that ether, in the concentration present in the blood under ordinary anesthesia will produce a marked decrease in the tone and extent of contraction.*

INFLUENCE OF ADRENALIN.

Early in the research it was noted that certain animals in shock, which had been resuscitated by adrenalin, after an overdose of ether, lost a large part of the sensitiveness to ether which they had previously exhibited. Further experiments established the fact that this was due to an influence of the adrenalin, probably on the heart. Fourteen cats were examined for the effect of adrenalin on the circulatory depression produced by ether. In this series large doses of adrenalin (from 0.1 to 1.0 mg.) produced either a complete disappearance of the previously existing sensitiveness to ether, or it was markedly decreased. *The fact that adrenalin reduces the effect of ether, at once suggests that it also acts through the heart in an antagonistic manner. Since there is no good evidence that the fall in blood pressure resulting from the administration of ether is caused by an effect on peripheral vessels, it is unlikely that the protecting effect of adrenalin can be ascribed to its effect on the blood vessels. Pituitrin, which is practically without influence on the heart, but which causes strong contractions of smooth muscle of the arterioles, is absolutely without effect in influencing the blood pressure fall from ether. If the fall were due to an effect on the peripheral resistance, it should become less after the administration of pituitrin.*

THE DIFFERENT EFFECTS OF ETHER ON THE CIRCULATORY SYSTEM AND HEART IN THE NORMAL AND SHOCKED ANIMALS.

In the normal animal there is a constriction of the peripheral vessels during ether anesthesia. This is indicated by plethysmograph studies of the hind leg, which uniformly show a decrease in volume during the inhalation of ether, and also by determination of the time of perfusion of a fluid through the blood vessels of the hind limb, there being a marked slowing of the rate under ether. *Further evidence was obtained from the effect of the injection of a saturated solution of ether in normal saline directly into the circulation. When the injection was made into an artery towards the head there resulted a marked rise in arterial pressure, while, when injected into a vein towards the heart, there was a fall in pressure.* This effect of ether in causing a constriction of the peripheral arterioles is true in the normal animal only. In severe shock there is no evidence of an increased constriction resulting from the administration of ether, and the normal reactions become less or are entirely absent.

The experiments mentioned above suggest an explanation for the depressive action of ether on the blood pressure in shock. *It seems probable that even in the normal animal the immediate effect of ether is a depression of the heart which accounts for the primary fall in blood pressure, but that the decreased heart output is soon compensated for by a reflex peripheral constriction, and possibly by a direct stimulation of the vasoconstrictor center by ether. The pressure thus returns to the normal level where it remains, provided that the etherization is not carried to an extreme degree. In shock, on the other hand, while there is a similar depression of the heart, there is an impairment of the normal vasomotor reactions and the compensatory constriction fails to take place, and thus there is a continued fall in blood pressure.*

The question of how the various agencies act, which cause a disturbance in the normal circulatory control, deserves further consideration. The condition of ether sensitiveness is always associated with shock, and is gradually developed under any circumstances that depress the general bodily condition of the animal, especially low blood pressure, and, as indicated above, the influence seems to be on the vasomotor center or peripheral mechanism rather than on the heart. Experiments, previously mentioned, indicate that the fall in blood pressure, resulting from ether, is brought about through an effect on the heart and that this is normally compensated for, to a considerable extent, by a peripheral constriction mediated through the vasomotor system. In shock this mechanism appears to be no longer functioning, with the result that ether causes a continuous drop in pressure as the depth of anesthesia is increased. Two possible explanations suggest themselves to explain this change in the reaction of the circulation to ether. There is some evidence that the low blood pressure accompanying shock results in a depression of the vasomotor center, so that it no longer reacts in a normal manner to a fall in pressure or other stimulus. Secondly,

there is the possibility that in this condition of ether sensitivity there already exists a maximum contraction of the arterioles so that there is no possibility of a further increase in the peripheral resistance to compensate for the lessened output of the heart. The increase in the depressive effect of ether occurring immediately after a severe hemorrhage must be explained on the latter assumption, and possibly also that occurring in the early stages of shock. This is supported by a series of experiments recently completed on the perfusion time of normal saline through the vessels of the hind limb during the development of shock. There was found to be a gradual decrease in the perfusion rate indicating an increased constriction of the peripheral vessels.

SUMMARY.

The main points of the research may be briefly summarized as follows:

1. In the normal animal, ether, rapidly administered, causes a moderate fall in blood pressure, followed immediately by a recovery, so that by the time a degree of anesthetization is reached sufficient to cause a disappearance of the eye reflex, the pressure is normal. In shock the animal becomes very sensitive to ether, the same degree of anesthesia produced under exactly similar conditions resulting in a marked drop in blood pressure.

2. An increased sensitiveness to ether is brought about by any circumstances which tend to depress the general condition of the animal such as low blood pressure, hemorrhage, severe operation, or the injection of acid into the circulation.

3. In a shocked animal, sensitive to ether, nitrous oxid and oxygen may be given in the most favorable proportions, so as to produce the same degree of anesthesia produced by ether without causing a fall in blood pressure.

4. Experiments on the heart volume in intact cats, and on contractions of the isolated turtle heart, together with deductions from blood pressure, show that ether, from the very beginning of its administration, results in a depression of the heart and a decrease in its output, which is sufficient to account for the fall in pressure in both the normal and the shocked animal.

5. Large doses of adrenalin injected intravenously in shocked animals usually results in the disappearance of the sensitiveness to ether for a period of an hour or more. The evidence indicates that adrenalin acts on the heart in a manner which antagonizes the effects of ether. Pituitrin does not influence the pressure drop produced by ether in the shocked animal.

6. Determinations of leg volume with a plethysmograph, perfusion experiments, and results obtained from the injection of ether directly into the circulation, together with the form of the blood pressure curves, indicate that ether causes a contraction of the peripheral vessels in the normal animal. This construction is caused (*a*) by a direct stimulation of the vasomotor center and (*b*) by a reflex to the fall in pressure resulting from depression of the heart. In shock no evidence of a vasoconstriction produced by ether was obtained, and pressor effects from asphyxia or sensory nerve stimulation become less or are entirely absent.

7. The cause of the greater depressing influence of ether on the blood pressure in shock, is a disturbance of the vasomotor system. The usual compensatory constriction no longer occurs to offset the decreased output of the heart, so that there is no recovery of the blood pressure during the inhalation of ether, but instead, the pressure continues to fall. This might be due to a depression of the vasomotor center or to an already existing maximum constriction, so that there would be no compensation.

240 LONGWOOD AVE.

Book Review

Handbook of Anesthetics. By J. STUART ROSS, M.B., Ch.B., F.R.C.S.E.; with an introduction by H. ALEXIS THOMSON, C.M.G., M.D., F.R.C.S.E., and Chapters upon Local and Spinal Anesthesia by WM. QUARRY WOOD, M.D., F.R.C.S.E., and Upon Intratracheal Anesthesia by H. TORRANCE THOMSON, M.D., F.R.C.S.E. WILLIAM WOOD & Co., Publishers, New York City.

Ross' book is an attempt to present to the student and practitioner a condensed account of modern anesthetic views and practice. He has tried to lay emphasis upon the relation of anesthesia to general medical science rather than to elaborate upon descriptions of anesthetic apparatus and methods which a few years hence may be superseded. He devotes the initial chapters of his book to an account of the various forces which modify the physiology of the patient during an operation under a general anesthetic in the hope that such knowledge will provide a sound basis for forming a judgment upon new methods and appliances as they are being used in the current practice of anesthesia. Mr. Wood contributes special chapters on local and spinal anesthesia and Dr. Torrance Thomson adds a monograph on intratracheal aesthesia. The volume is replete with valuable information.

American Journal of Surgery

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F. HOEFFER McMECHAN, A.M., M.D., *Editor*
Avon Lake, Ohio, U.S.A.

JULY EDITORIALS 1920.

THE REAL PROBLEM IN ANESTHESIA.

The following editorial from *The Medical Brief*, April, 1920, is of very pertinent interest to all anesthetists.

"The crucial question in anesthetics is that of their comparative safety to life, consistent with a sufficient profound degree of anesthesia. We say *comparative safety;* for it seems to be universally recognized that there can be no anesthesia at all without some degree of risk to life. This apparently established fact is the pivotal center about which all the discussions and arguments circle around, without ever seeming to get any nearer to the inner significance of the fact itself. In the complex multiplication of ulterior considerations, the simple elementary truths of anesthesia appear to have been lost sight of, and to need restating.

The primary purpose of anesthesia, of course, is to relieve the patient of the physical and mental anguish attendant upon a surgical operation. Secondarily, it is desirable to relax the musculature enough to enable the operator to work more leisurely and thoroughly, and with less traumatism to the tissues. As a matter of cause and effect, however, this latter condition is a sequitur of the former, since the objectionable tension and resistance are brought about through the physical and mental irritation referred to.

This suffering of mind and body is not, in the last analysis, a phenomenon of neurons and reflexes, but of sentient consciousness. From the physiologist's point of view there is no such thing as subconsciousness; attention is associated with every mental process, and a sensation implies the exercise of a certain amount of attention. In the highly developed organism of a human being, no part or function is normally exempt from this mental attention or consciousness. There are no short-circuit reflexes. Every periphery, whether cutaneous, muscular, vascular, visceral, or what-not, is directly in the circuit of the brain, and both influences and is influenced by the brain. The day of regarding spinal arcs as independent centers, and the so-called spinal reflexes as performed independently of the brain, has long since gone by. We know that apart from cerebral influence they cannot be performed at all, and some degree of mental attention enters into every functional process.

The problem for anesthesia is to create an interruption in these long circuits, between the peripheries which are to be attacked in surgical operation and the sentient centers in the cerebrum, of sufficient effectiveness to prohibit a reaction of the former in the latter, but not sufficient to cut off that influence of the latter upon the former which is necessary to the maintenance of life and vital function. The real danger in the process lies in the fact that under anesthesia profound enough to confer immunity from sensation, the vital functions, to the extent of their anesthetization, are temporarily deprived of that quickening and equalizing influence of the brain which normally acts both as a safety gauge and a governor of the vital forces.

Judged from this standpoint, local anesthesia is of course the ideal condition for operation; that is to say, an interruption of those circuits only which connect the circumscribed field of operation with the sentient centers, leaving all other structures and functions of the body in integral communication with the brain. Such a condition not only preserves, whole and active, a thousand channels through which the organism clings to life for one channel that it suspends, but the abnormal reaction of the temporarily impaired function, registering itself through the many intact communications with the rest of the organism, will maintain an equalization which will quickly restore normality to the part when the anesthetic is withdrawn.

Unfortunately, the practicable range of local anesthesia is very limited. In far the greater proportion of cases we are clumsily obliged to interrupt all the circuits for the purpose of catching within the zone of interruption the particular cir-

cuit with which we are concerned—very much like the old Chinese trick of burning the house down to roast the pig. This is accomplished by chemical agents—ether, chloroform, etc.—which exert their somnolent effects from above downward, impairing first the circuits of higher consciousness and gradually depressing the sentient centers until even the lower reflexes scarcely react in them.

More recently a move has been made to popularize a method whose modus operandi is midway between that of a general and a local anesthetic—the so-called spinal anesthesia. The problem and essential danger, however, are identical with those of the older method, namely, the delicacy of the balance between interruption of sentient and that of vital circuits. Considerations of blood pressure, respiration waves, and the like, are mere straws on the surface, showing which way the tide is flowing. The real underlying element of danger in the anesthetized organism is that it is cut off from its supreme control of its own vital function, and while thus cut off in every circuit, the least overstepping of the vital limit in any one important circuit fails to register itself in the cerebral clearing-house, so that no compensatory process is invoked, and the organism succumbs.

That method of anesthesia which will enable us to block only that particular circuit concerned in the operation is, of course, the ideal method. Failing that, or until that be attained, the method which affords the greatest available facility for measuring and regulating the degree of sentient interruption, and maintaining the greatest degree of vital integrity of the long circuits, must be regarded as the most desirable system of anesthesia."

THE UNIVERSITY OF MARYLAND MEDICAL SCHOOL APPOINTS A PROFESSOR OF ANESTHESIA.

The editor of the Supplement is in receipt of information that the University of Maryland Medical School, which several years ago created a separate Department of Anesthesia with Dr. Griffith S. Davis, of Baltimore, at its head, has made him a full Professor of anesthesia. This is one of the first professorships of anesthesia to be established in this country and it is to be hoped that all medical schools, worthy of the name, will soon follow the example set by the University of Maryland.

It is understood that a great deal of interest is also being taken in the teaching of anesthesia in the University of Maryland Dental School.

THE MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA AND THE NURSE ANESTHETIST.

At a recent and largely attended meeting of the Medical Society of the District of Columbia the following Resolution was adopted by a vote of over 5 to 1 of the members present.

Resolved that the Medical Society of the District of Columbia go on record as in favor of the limitation of the practice of anesthesia to regularly licensed physicians, surgeons and dentists, and graduate nurses in cases of emergency or medical students for purposes of instruction.

As the Medical Society of the District of Columbia has a membership of 1237 physicians, a number greater than the membership of some 15 other state medical societies, this expression of opinion carries a great deal of weight.

Efforts by proponents of the lay anesthetist to defeat this Resolution by all sorts of parliamentary tactics were voted down repeatedly and almost unanimously.

It is to be hoped that prominent anesthetists throughout the country will have their local, county and state societies take similar action. Also in support of the movement of the American Association of Anesthetists it is very desirable that every state medical association be induced to pass the following Resolution:

Whereas the safety of patients, progress of surgery and hospital service demand the rapid extension of the specialty of anesthesia, therefore

Be it resolved that the ..... State Medical Association hereby instructs its Delegates to secure the establishment of a Section on Anesthesia in the American Medical Association at the Boston meeting, June, 1921.

Any developments in this connection should be notified to Dr. James T. Gwathmey, 40 East 41st St., New York City.

THE CALIFORNIA STATE MEDICAL SOCIETY AND NON-MEDICAL PRACTITIONERS OF THE MEDICAL SPECIALTIES.

The following excerpt from an editorial in the June issue of the Southern California *Practitioner* points out the commercial attraction of the medical specialties to non-medical practitioners and details the action of the California State Medical Society, at the recent Santa Barbara meeting on the use of lay persons as anesthetists:

"Medicine, the noblest of professions, is the most

despicable of business. The worshiper of mammon is a decidedly incongruous figure in the altruistic field of the practice of medicine. The essential respectability that has long been recognized as a characteristic of the honorable members of our profession, is attractive to the commercially inclined unqualified practitioners of the healing art, and is often unsuccessfully aped by them. A stronger attraction to the unqualified non-medical practitioners of the medical specialties is afforded by the possible financial returns. The remuneration of the practice of medicine is absurdly low for those who are properly qualified, so much so that the practice of medicine is no longer regarded as an attractive field in a financial way. But to the unqualified the practice of the medical specialties promises financial returns out of all proportion to the true worth of the services they are able to render in this or any other way, so that they are tempted to be unscrupulous in the extreme and to resort to all sorts of expedients to enable them to continue in their dangerous practices.

"At the Santa Barbara meeting, our State Medical Society declared that the administration of an anesthetic is always the function of a legally qualified medical practitioner; that the administration is best performed by physicians specially instructed or who have made a specialty of this subject; that wherever available, hospitals and public institutions, where anesthetics are administered, employ only physicians as anesthetists; that the Society condemns under all circumstances the training and qualification of lay persons as anesthetists; that no hospital shall be deemed to have acceptable standards, which charges a fee for anesthetics unless such anesthetic has been administered by a legally qualified physician.

"The more closely this action of our State Society is scrutinized, the more we must be impressed by the good judgment it portrays."

Society Proceedings

Membership in a society devoted to your specialty is an essential to success.

INTERSTATE ASSOCIATION OF ANESTHETISTS SIXTH ANNUAL MEETING; JOINT SESSION WITH THE PENNSYLVANIA STATE MEDICAL ASSOCIATION AND THE NATIONAL ANESTHESIA RESEARCH SOCIETY.

The Interstate Association of Anesthetists will hold its Sixth Annual Meeting in Pittsburgh, Pa., October 4-7, in conjunction with the Pennsylvania State Medical Association and the National Anesthesia Research Society. This will be one of the most interesting and important meetings ever held and all activities will be centered in the Hotel William Penn.

The National Anesthesia Research Society will award money prizes for the three best papers presented on researches in anesthesia. Those wishing to compete should get in touch with the secretary at once.

On Thursday afternoon, October 7, there will be a Joint Session with all the sections of the Pennsylvania State Medical Association and the following papers will be presented:

Blood Pressure Guides in Anesthesia and Operation. A. H. Miller, Providence, R. I.

Acidosis, Ketonosis and Alkylosis in Relation to Anesthesia and Operation. S. P. Reimann, Philadelphia, Pa.

Third Stage Ether Anesthesia—A Subclassification. Arthur E. Guedel, Indianapolis, Ind.

The Anesthesia Problem in Lung Surgery. James T. Gwathmey, New York City.

Nitrous Oxid Anesthesia in Normal Labor and Operative Obstetrics. W. C. Danforth, Evanston, Ill.

Nitrous Oxid-Oxygen Anesthesia for Oral and Sinus Surgery in the Forward Inclined Sitting Posture. Ira O. Denman, Toledo, O.

Other papers scheduled for the tentative program are:

Further Studies in the Effects of Anesthetics on Animals Infected with Tuberculosis Through the Respiratory Tract. J. B. Rogers, Cincinnati, O.

Further Studies in Blood Changes Under Nitrous Oxid. T. D. Casto, Philadelphia.

Further Studies in the Effects of Carbon Dioxid Inhalations After Ether Anesthesia and Operation. Yandell Henderson, New Haven, Conn., and R. C. Coburn, New York City.

Studies in Blood Pressure Reactions Under Ether-Oil Colonic Anesthesia. G. M. Geldert, Ottawa, Canada.

Air Control and the Reduction of Death Rate After Operation. E. Huntington, New Haven, Conn.

Draw-Over Ether Anesthesia with a Study and Report of Routine Results. A. S. McCormick, Akron, O.

The Oral Administration of Nitrous Oxid-Oxygen Anesthesia for Prolonged Neurological Operations. George W. Tong, New York City.

Anesthesia for Operations on Children. W. Beach, Philadelphia.

The Nasal Administration of Nitrous Oxid-Oxygen Anesthesia for Long Oral Operations. Bissell Palmer, Jr., New York City.

Nitrous Oxid-Oxygen-Anesthol Anesthesia for Extraction Operations. M. Ecker, New York City.

Lessons from Non-Fatal Accidents Under Anesthesia. R. M. Waters, Sioux City, Iowa.

Primary and Secondary Nitrous Oxid Saturation as a Test of the Patient's Capacity for Withstanding Operation. E. I. McKesson, Toledo, O.

The Hemoglobin Content as an Index of Oxygen Requirement During Anesthesia. W. I. Jones and Clayton McPeek, Columbus, O.

Clinical Observations on Anesthetizing the Tuberculous. W. J. Hunnicutt, Asheville, N. C.

Bodily Changes and Reactions to Low Tensions of Oxygen. E. C. Schneider, Mineola. L. I.

An effort is being made to have the Western Pennsylvania Odontological Society cooperate in the Session on Anesthesia for Oral Surgery and Dentistry.

If possible Clinics to demonstrate some of the latest advances in anesthetic technic will be held on Wednesday and Thursday morning previous to the Scientific Sessions.

The Annual Dinner will be held in the Hotel William Penn on Tuesday evening, October 5.

As usual,the Visiting Ladies will be delightfully entertained and you are requested to notify the Secretary in advance how many will be in your party.

As the Hotels William Penn and Fort Pitt are under the same management reservations in either will secure you the best of accommodations and service during the meeting. Make your reservations at once.

For further information and details address F. H. McMechan, M. D., Secretary, Avon Lake, Ohio.

AMERICAN ASSOCIATION OF ANESTHETISTS—EIGHTH ANNUAL MEETING.

The American Association of Anesthetists held its Eighth Annual Meeting at the Grunewald Hotel, New Orleans, La., April 26-27, with Dr. A. H. Miller, Providence, R. I., in the chair.

During the opening Executive Session the minutes of the 1919 meeting at Atlantic City were accepted as read. The Secretary-Treasurer's report was also accepted as presented. The following officers were elected for the forthcoming year: President, Dr. Jos. E. Lumbard, New York City; Vice-Presidents, Dr. F. L. Richardson, Boston, Mass., and Dr. Eleanor Seymour, Los Angeles, Cal.; Secretary-Treasurer, Dr. F. H. McMechan, Avon Lake, O.; Executive Committee, Dr. John J. Buettner, Syracuse, N. Y., and Dr. Paul Lux, Kansas City, Mo.

The following anesthetists of the allied professions were elected to membership: Drs. Lewis S. Booth, New York City; Robert Burrows, San Francisco; Archer C. Bush, Verona, N. J.; McKeen Cattell, Boston; Etta Charles, Anderson, Ind.; Harry T. Cooke, Los Angeles; Arthur M. Dodge, Boston; Bernard C. Dorset, Denver; M. Ecker, New York City; Arthur E. Guedel, Indianapolis; Harry Harrison, Norfolk; O. C. Hickman, Denver; W. J. Hunnicutt, Asheville, N. C.; W. I. Jones, Columbus, O.; Nettie Klein, Texarkana, Texas; E. O. Laughlin, Paris, Ill.; Mary A. Leavitt, Boston; F. H. Mathews, Providence, R. I; C. W. Metz, Denver; Samuel W. Moore, Baltimore; L. A. Rithwilm, San Francisco; Karl F. Roehrig, Denver; Olin W. Rodgers, Knoxville; Lucretius H. Ross, Bennington, Vt.; S. E. Sawyer, Lewiston, Me.; Arthur T. Schoonmaker, Westfield, Mass.; Roy C. Seamans, Batavia, N. Y.; O. H. Seifert, Springfield, Ill.; Albert E. Small, Melrose, Mass.; J. P. Wahl, New Orleans, and Marion L. White, Dixon, Ill.

During the scientific sessions papers were presented by the following: Drs. A. H. Miller, Provideence, R. I.; F. C. Mann, Rochester, Minn.; McKeen Cattell, Boston; Jos. E. Lumbard, New York City; Ralph M. Waters, Sioux City, Ia.; John R. Worley, Dallas, Texas; James T. Gwathmey, New York City; Ansel M. Caine, New Orleans; E. I. McKesson, Toledo, O.; A. Ficklen, New Orleans, and George Piness, Los Angeles.

The Symposium on the Problem of Anesthesia in Goiter Operations was participated in by the following: Drs. André Crotti, Columbus, O.; Vilray P. Blair, St. Louis; W. E. Lower, Cleveland; Lincoln T. Sise, Boston; Carroll W. Allen, New Orleans, and Walter Lathrop, Hazelton, Pa.

During the second Executive Session the Secretary was instructed to cooperate with the Surgeons General of the United States Army and Navy in accomplishing the initiation and maintenance of expert anesthesia in these services. The following resolution regarding the lay-anesthetist was unanimously adopted:

Whereas, The American Association of Anesthetists is committed to the advancement of the science and art of anesthesia in all that relates to the welfare and humanity, through the medical and dental professions, and

Whereas, The advances in medical science are making it increasingly clear that the administration of anesthetics is a factor of practically equal importance with diagnosis, treatment and operation, and

Whereas, There is an increasing disposition on the part of a few surgeons and hospitals to commit the administration of anesthetics to nurses, office assistants and others without adequate qualifications, exploiting such services to their commercial advantage, according to testimony adduced before this association, thus jeopardizing the health and welfare of patients and increasing the death rate in operations, and

Whereas, Anesthesia is in a state of evolution and those who advocate lay anesthesia would defeat any further progress in this branch of medicine,

Therefore, be it resolved, That the American Association of Anesthetists places itself on record as unalterably opposed to the employment of lay anesthetists, nurse anesthetists and all other types of anesthetists who shall not have graduated from recognized medical or dental colleges and have been licensed to practice medicine or dentistry, and

Be it resolved further, That the American Association of Anesthetists will inaugurate and prosecute legislation to protect the medical and dental profession and the public from such inadequately educated and trained anesthetists whenever such action is necessary.

The resignations of the following members were accepted with regret: Drs. Lillian Mueller, Indianapolis; H. B. Patterson, Pittsburgh; H. A. Sanders, Pasadena, Cal.; and G. F. Sammis, Brooklyn.

To carry out the welfare proposals made in the address of the President, the Association voted unanimously to have him appoint standing committees on Records and Statistics, Instruction in Anesthesia in Medical Schools and Hospitals, Anesthetic Agents and Methods, Revision of the Constitution and Organization and Relations with Medical and Surgical Societies.

The Secretary was voted an appropriation of $300 for his services during the past year.

The Annual Dinner was well attended and enjoyed by all. The Secretary acted as Toastmaster and after-dinner speeches were given by Dr. Charles Chassaignac, New Orleans; Dr. John Osborn Polak, Brooklyn; Prof. Desmarest, Paris, France; Mr. James McLoughlin, New Orleans, and Commander W. Seaman Bainbridge, M. C., U. S. N. R., New York City. The Association also was honored by having as its guests the ranking officers of the medical service of the Cuban Navy and Army, Lt.-Com. Feugera and Major Guerrera.

Through the courtesy of Mrs. Ansel M. Caine and other wives of New Orleans physicians the visiting ladies of the anesthetists were delightfully entertained, Tuesday noon, at luncheon at the Yacht Club and were later taken on an auto sight-seeing trip of the city, stopping at the Country Club for the The Dansant.

The Association adjourned to meet in Boston, June, 1921, the first two days of A. M. A. week.

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October 1920

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ADVANCES IN PURE NITROUS OXID-OXYGEN ANESTHESIA: WITH A CONSIDERATION OF CYANOSIS, THE SIGNS OF ANESTHESIA AND A DESCRIPTION OF THE TECHNIC OF SECONDARY SATURATION.*

E. I. McKesson, M.D., Anesthetist,
Toledo, Ohio.

In the preliminary, or induction stage of nitrous oxid-oxygen anesthesia, it is the usual practice to administer 100 per cent. nitrous oxid to produce unconsciousness as soon as possible by a primary saturation of the blood with the anesthetic gas. Very soon, however, a small amount of oxygen must be mixed with the nitrous oxid to prevent the jactitations and other manifestations of acute anoxemia. Now, if some fixed proportion of oxygen is decided upon it will be found *too small* for some and *too great* for others since patients differ in their mixture requirements. All of this is well known to gas-oxygen users. Preliminary, or what may be called *primary saturation* with nitrous oxid is about as far as many gas-oxygen anesthetics are carried, if the operation requires deeper relaxation it is the practice of many anesthetists to resort either to a mixed gas-oxygen-ether, or to a sequence ether with little or no attempt to avoid the unpleasant consequences.

It is not necessary to use ether in order to relax an abdominal wall—as it may be accomplished with gas-oxygen, by secondary saturation.

In a primary saturation only the actively circulating blood is saturated before oxygen must be administered. There remains in the muscles, and in all other tissues, considerable volumes of nitrogen and oxygen, which in the early minutes of narcosis enter the blood stream and dilute the nitrous oxid, which prevents a deeper anesthesia. In order to displace more of the non-anesthetic gases in the body with nitrous oxid, the technic to be described as secondary saturation has been devised.

PRELIMINARY OBSERVATIONS.

Any general anesthetic relaxes muscle, providing some coincident by-product or effect does not counteract this function.

In nitrous oxid anesthesia we may have sufficient anoxemia to produce muscular spasm when there would have been relaxation had the anoxemia been prevented. Yet by the usual technic it has not been possible to prevent the anoxemia and still have sufficient nitrous oxid concentration. Resaturation, or secondary saturation after the primary or induction saturation has been followed with oxygen, is the means of eliminating the excess of non-anesthetic gases and thus increasing the amount of anesthetic gas and oxygen in the desired proportions to produce anesthesia with relaxed muscles.

Eleven or twelve years ago in my early experience with gas-oxygen occasionally patients were accidentally overdosed with nitrous oxid, stopping respiration and requiring resuscitation with oxygen. I was impressed with the extreme ease and quickness of the restoration by inflating the lungs once or twice with oxygen. The phenomenon was so unusual when compared with the difficulties which followed accidental overdosage with ether or chloroform that it made a profound impression.

In attempts to secure deep anesthesia and muscular relaxation, these observations became more commonplace and it was soon learned that cyanosis, a dilated pupil, and apnea were easily corrected by inflating the lungs once or twice with oxygen, and that while these signs could not be disregarded nor neglected for a moment when they became apparent, nevertheless, the patient was in no serious danger if oxygen were available and put into the lungs promptly after saturation had occurred.

Another phenomenon was observed in this connection which has since been a most important means of securing a flacid abdominal wall. When fully utilized it has made it possible for me to obtain for the patient the full advantages of a pure gas-oxygen anesthesia and to eliminate from my practice the unpleasant and sometimes disastrous sequelae which even a small amount of ether produces. The phenomenon was this: *When a patient had been reoxygenated after resaturation complete muscular relaxation followed, and a patient who, prior to that time, had been too rigid for easy abdominal exploration was now ideal from the surgeon's point of view.*

At first the fear of accident prevented the intentional utilization of this procedure in clinical practice and only in accidental overdosing was further observations made. The patients were studied from many angles; careful records of pulse, respiration, blood pressures, pulmonary ventilation, rebreathing, and the mixture of gas-oxygen were tabulated on every patient during the narcosis that an opportunity to study a case when one presented might not be lost.

These observations of blood pressures and other factors, unexpectedly exploded the theory that gas-oxygen elevated the blood pressure and, therefore, the danger from this factor was eliminated as early

*Read during the Eighth Annual Meeting of the American Association of Anesthetists, Hotel Grunewald, New Orleans, April 26-27, 1920.

as 1911 and reported at a previous meeting of this Association.

After 3 or 4 years observations of these occasional cases the conclusion was reached, that a patient might be crowded to the limit of saturation without great danger if oxygen could then be instantly forced into the lungs. The method was tried in those cases, at first, in which ether was clearly contraindicated and in whom sufficient relaxation by the usual technic for pure gas-oxygen was not readily obtainable. Gradually its use has been extended to include *any* case in which marked relaxation of abdominal muscles is desired.

Many times patients have been brought from what appeared to be a well developed fourth stage, with dilated, fixed pupils, the deepest cyanosis, complete spastic apnea, and general board-like rigidity, into a beautiful placid relaxed pink patient in from 10 to 20 seconds with every appearance of normal slumber.

This illustrates the remarkable flexibility of nitrous oxid and oxygen and its wonderful safety, but it also illustrates the important clinical fact that a patient may be more completely saturated with nitrous oxid than has been generally practiced or thought possible.

THE PRINCIPLE OF N_2O-O SATURATION.

The principle of nitrous oxid saturation is not radically different from ether or chloroform saturation. It requires, of course, a much higher concentration for a few moments than is required with the latter agents and to secure this concentration, oxygen is temporarily cut off or markedly reduced below the proportion which will be administered after the saturation.

In most gas-oxygen anesthetics as given in the past, the patients have been only partly saturated, and reflexes, or rigid muscles resulted just as occurs under light anesthesia with ether, chloroform, or any other general anesthetic.

Because of the essential differences between the affinity of ether or chloroform for the tissues and their very low affinity for nitrous oxid any certain degree of saturation has been difficult to maintain without very accurate administering appliances and a more accurate appreciation of signs indicating changes in the depth of narcosis under the latter agent.

The extraction specialists of years ago and today produced primary saturation and approached secondary saturation in many of their obstreperous patients before beginning to extract teeth. Had they required the relaxation needed in abdominal surgery and possessed the means for using oxygen which we now have, the technic for secondary saturation no doubt would have been developed by them, because they were not afraid of cyanosis, which is the stumbling block in the minds of the ether or chloroform-trained anesthetists and surgeons. The extractionists soon learned that nitrous oxid (without oxygen) usually produced anesthesia slightly later than the onset of well marked cyanosis and he, therefore, rarely removed the inhaler until his patient was fairly black. Yet under such a technic with all sorts of patients he established a record for safety with nitrous oxid which has not been approached by any other anesthetic agent.

THE PROBLEM OF CYANOSIS.

The fear of cyanosis by the surgeon and anesthetist has been one of the most powerful influences in holding back the progress of nitrous oxid and oxygen. It is the most natural thing to administer oxygen when the skin becomes dusky and to stop the further development of narcosis by so doing. General ignorance concerning the significance of cyanosis itself and how much cyanosis from a certain cause will be tolerated for certain periods of time, are subjects worthy of investigation and review.

Cyanosis as a sign indicating the depth of anesthesia, is not only absolutely valueless but misleading and dangerous, because one patient may be cyanotic and still conscious, or even fighting, while another may be pink, overdosed and dying from the same mixture of nitrous oxid and oxygen.

The following unusual and remarkable case in my recent experience illustrates this point: Mrs. C., a middle-aged woman, had twelve infected teeth to be removed. She had four or five blood transfusions, one recently, for an anemia of four years' standing. The hemoglobin index was 27 per cent. and the red cell count 1,250,000. She was excitable, weak, and spent much of her time in bed. Nitrous oxid-oxygen was selected by the consultants as the safest anesthetic for this patient. The usual technic of induction with 100 per cent. nitrous oxid was begun January 5th, 1920, but at the end of the third inhalation, while the ear and nails were distinctly pink, (they had been previously quite pale), respiration stopped, the eyelids opened, and the pupils had dilated until only a ring of iris could be seen. The muscles were completely *relaxed* in every part of the body. The carotid pulse was weak but regular and easily felt.

The lungs were at once inflated or about half filled with oxygen—*twice*, and within ten seconds

the iris began to contract; within a few more seconds respirations resumed regularly.

On account of the few breaths required to thus overdose patient, it was evident that the nitrous oxid would need to be highly diluted with oxygen to prevent recurrence and, therefore, the apparatus was set for 30 per cent. oxygen and only 70 per cent. nitrous oxid. But the same signs recurred within 5 or 6 breaths, and again she was recovered with two inflations of oxygen. Now, 50 per cent. oxygen and 50 per cent. nitrous oxid was administered and after several breaths the pupil began to slowly dilate and respirations became weaker. After a breath of 100 per cent. oxygen was administered, and to prevent the further development of overdosage 40 per cent. nitrous oxid was next tried. This mixture proved to be the ideal mixture for the patient and no further difficulty was experienced while the operation proceeded.

The operation lasted 20 minutes in which the teeth were removed, the aliveolar process trimmed smooth with rongeurs the gum margins trimmed and sutured so as to restore mastication by artificial dentures within a few days.

Semi-consciousness following the operation lasted for 30 minutes (instead of a few seconds) which was no doubt due to her unusually weak condition and to her anemia.

While it is still too early to determine the ultimate results of the operation there has been a gradual improvement up to the present time.

Besides illustrating the fact that a patient may be overdosed with nitrous oxid without showing cyanosis, this extreme case emphasizes the importance of the true signs of anesthesia as a guide to the anesthetist, and the necessity for being prepared to surely resuscitate a patient when respirations are accidentally stopped by over-saturation with nitrous oxid regardless of the proportion of oxygen which may have been used up to that time. Another unusual phenomenon occurred in this case: the moment when overdosage occurred each time, as well as at other times, there was no muscular rigidity, but extreme relaxation instead, because no time was there anoxemia or cyanosis to produce spacticity. In the usual case when saturation is first attained the coincident anoxemia causes the muscles to become boardlike or spastic, but relaxation comes promptly when sufficient oxygen is restored to them. In the case described we had sufficient nitrous oxid concentration to produce relaxed muscles, and at the same time enough oxygen in the mixture to prevent anoxemic spasticity.

PRIMARY AND SECONDARY CYANOSIS.

Cyanosis may be classified as primary and secondary: *Primary* due to changes in the blood itself, and *secondary* due to local or external causes capable of increasing the oxygen depletion of the blood. Cyanosis is due to the deoxidation of oxyhemoglobin to reduced hemoglobin—it is a physiological process carried beyond the usual limits.

Blood normally leaves the lungs about 95 per cent. saturated with oxygen, therefore having only 5 per cent. unsaturated. There will be a larger portion of it unsaturated if aeration is interfered with by inspired mucous, blood, a restricted airway, or by a reduction of the oxygen administered as in anesthesia.

That cyanosis per se is not incompatible with life is illustrated in Morbus Caeruleus, aviation, pneumonia, and in bathers exposed to cold air.

In old age when metabolism is lower, less oxygen is consumed in the tissues, and less cyanosis reults from oxygen restriction. The old folks are usually ideal patients for gas-oxygen, easily handled and rarely requiring secondary saturation to produce relaxation. The young adult on a similar oxygen percentage in the anesthetic mixture usually shows a greater degree of oxygen unsaturation and more cyanosis.

The flow rate of the blood may be altered so as to increase oxygen unsaturation or cyanosis in terminal toxemias, such as peritonitis or endocarditis, or again from a deficient septum between the ventricles.

Then the blood itself greatly influences cyanosis: The anemic patient on a given mixture of nitrous oxid and oxygen producing normal anesthesia, obtains enough oxygen to oxidize the small quantity of hemoglobin she carries while the full-blooded drayman on the same mixture would probably be cyanotic because the oxygen would be sufficient only to oxidize from 50 to 75 per cent. of his hemoglobin.

In well marked anemia, with less than 50 per cent. hemoglobin cyanosis is rarely seen, with 30 per cent. or less, cyanosis cannot ordinarily be produced before death.

It is, therefore, obvious that the fear of cyanosis is sometimes well founded and at other times unwarranted. Under ether or chloroform, cyanosis is usually a serious omen—an indication of serious heart embarrassment, or restricted respiration from overdosage or other causes. It is not usually due to a restriction of oxygen administered or inhaled.

In thousands of administrations degrees of cyanosis have been produced for variable lengths of

time under nitrous oxid-oxygen with no ill effects, which if seen under chloroform or ether would in a fair percentage of cases result fatally. The difference is in the cause.

TOLERATION OF CYANOSIS.

In an operation case one must be able to determine the cause of cyanosis if it occurs, and whether it is controllable or not—before concluding that it is detrimental. *A patient will tolerate very deep cyanosis for some minutes, a moderate amount for hours and a slight cyanosis for long periods if due merely to a restriction of oxygen administered to the lungs for absorption.*

THE SIGNS OF ANESTHESIA.

The only true signs of anesthesia clinically which are of value, are those manifested through the patient's muscular system. Movement, or its absence, is significant. In the accompanying table color is tabulated principally to show its usefulness as a guide in order to counteract the often repeated statements in anesthetic literature regarding its supposed value.

The third stage of anesthesia as described in the text books is here divided into three planes:—light, normal, and profound anesthesia. The third plane or profound anesthesia, borders upon the

McKESSON'S N_2O-O SIGN CHART

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LIGHT ANESTHESIA	NORMAL ANESTHESIA	PROFOUND ANESTHESIA
Due to too much oxygen in the mixture.	Due to a properly balanced mixture of N_2O-O.	Due to too much N_2O in the mixture or to partial obstruction of respiratory passages.
RESPIRATION (a) Superficial slow breathing usually regular. (b) Prolonged inspiration. (c) Phonation due to reflexes or pain. (d) Holding breath, grunting.	**RESPIRATION** (a) Full "machine like" respirations. Regular and faster than normal. (b) Inspiration and expiration nearly equal. (c) No phonation. (d) Continuous uninterrupted respiration.	**RESPIRATION** (a) Irregular rhythm (sobby) usually slower than normal. Spasmodic. (b) Prolonged expiration. (c) Phonation due to muscular spasm of vocal cords. Often crowing. (d) Cessation of respiration from spasm of muscles of exhalation.
MUSCULAR PHENOMENA (a) Movements or rigid muscles. (b) Facial expression of pain or consciousness. (c) Nausea, very rarely. (d) Reflex, or voluntary resistance.	**MUSCULAR PHENOMENA** (a) Immobile and relaxed, but having normal muscular tonus. (b) Expression of normal sleep. (c) Quiet. (d) Quiet. Relaxed.	**MUSCULAR PHENOMENA** (a) Clonic movements, twitching or jerking in early minutes of induction, often start in upper eyelids. (b) Expression wild looking. (c) Swallowing, retching or vomiting, common. (d) Tetanic, spasm, marked rigidity—opisthotonus in some cases.
THE EYE (a) Pupils large, contract to light actively. (b) Conjunctive sensitive. (c) Eyeballs roll. (d) Eyelids resist opening, winks when touched.	**THE EYE** (a) Pupils small or medium fixed. (b) Conjunctive insensitive to touch. (c) Eyeballs fixed or slowly roll. (d) Lids often slightly open, relaxed, no winking.	**THE EYE** (a) Pupils fixed, enlarge progressively and finally become irregular in shape. (b) Conjunctive insensitive. (c) Eyeballs fixed in some position or jerk. (d) Eyelids stiff. Often wide open.
COLOR IN SKIN (a) Pink or no change normally. (b) In anemics, no color change (c) In plethorics, slight cyanosis.	**COLOR IN SKIN** (a) Varies from pink to decided cyanotic tint. (b) In anemics, no color change. (c) In plethorics, considerable cyanosis.	**COLOR IN SKIN** (a) Usually cyanotic. (b) In anemics, slight flushing, rarely cyanosis. (c) In plethorics, almost black.
REMEDY Decrease the percentage of oxygen in the mixture.		**REMEDY** Increase oxygen in the mixture or in (d) inflate lungs with pure oxygen 1 to 3 times.

fourth stage and merges into it with the (d) group of signs. The signs of the third plane are the guides to secondary saturation, as well as the limits of anoxemia, which are momentarily permissable in producing secondary saturation.

THE TECHNIC OF PRIMARY SATURATION.

Anesthesia is induced as usual by administering 100 per cent. nitrous oxid until the first muscular phenomenon of oxygen hunger is observed. This may be and is usually a change in character or rate of respiration accompanied by a little snort, a twitch of the eyelid, jerk of the hand or foot, or some similar anoxemic muscular contraction—clonic in character.

This is the patient's first signal for oxygen and marks the moment when oxygen should be added to the nitrous oxid in sufficient proportion or percentage to prevent temporarily the further development of anoxemia. What this percentage of oxygen shall be is determined by the susceptibility of the patient, which is roughly determined by the length of time required or the number of breaths of pure nitrous which the patient inhaled before anoxemia developed. If short, the percentage of oxygen may be greater than if anoxemia comes on slowly. But in the usual case with the first sign of anoxemia 5 to 6 per cent. oxygen is then mixed with the nitrous oxid, increasing or diminishing it, as the signs of anesthesia may indicate while attempting to obtain the *normal plane* of anesthesia. Thus, the first two or more minutes of narcosis will pass before it will be determined whether the *normal plane* can be secured without secondary saturation or not—whether it will be necessary to further saturate with nitrous oxid in order to rob the tissues of their excess of oxygen and nitrogen and thus prepare for muscular relaxation.

THE TECHNIC OF SECONDARY SATURATION.

If relaxation has not taken place when other signs indicate that the patient is in normal anesthesia and if relaxation is essential to the success of the operation, see that plenty of oxygen is available, and know by previous trial upon yourself that the apparatus will actually inflate the lungs with pure oxygen, then proceed to secondary saturation as follows:

A. DEOXYGENATION: Reduce the proportion of oxygen or administer 100 per cent. nitrous oxid until the pupil dilates (beware of glass eyes and an adherent iris), tonic muscular spasm or rigidity develops, respiration becomes slow or stops.

B. REOXYGENATION: Then administer one breath of 75 to 100 per cent. oxygen if the patient inhales, and if he does not, partly fill the lungs by inflation with pure oxygen once or twice—usually once is sufficient. The cyanotic color now begins to lighten, the pupils retract, the pulse is normal or slower than before, the muscles become perfectly relaxed and presently respirations resume.

If care is taken not to administer too much oxygen or too many breaths of oxygen, which will in itself, desaturate, the period of relaxation may last throughout the operation or it may be necessary to resaturate if air leaks into the respiratory channels of the apparatus, and thus displaces the nitrous oxid with an excess of nitrogen and oxygen in the blood.

There are also good reasons for believing that air is slowly but sufficiently absorbed through the skin and open abdomen to destroy the nitrous oxid saturation, in some cases necessitating resaturation at the time of closing the abdominal wound. At this time another advantage may be taken of the procedure to immobilize the abdomen for a few seconds while closing the peritoneum.

After reoxygenation of secondary saturation is begun there are from 5 to 20 seconds when the patient does not breathe because of the excess of oxygen in the blood and brain, and if this phase of secondary saturation is properly timed it not only gives the surgeon a perfectly flacid abdominal wall, but also a quiet peritoneum to sew.

CONCLUSIONS.

1. Primary saturation of the patient with nitrous oxid fails in some cases to produce sufficient relaxation for certain operations.

2. Nitrous oxid produces muscular relaxation when it is sufficiently concentrated in the tissues and associated with enough oxygen to prevent anoxemic rigidity. High concentration of this gas in the tissues is required to displace the non-anesthetic diluting gases.

3. The technic of secondary saturation which I have described and used extensively for several years, intensifies nitrous oxid anesthesia and produces sufficient relaxation for any operation.

4. Secondary saturation is readily lost by subsequent errors in the mixture administered, leaks of air into the patient's air passages and probably by absorption of air through the abdominal cavity and skin requiring occasional resaturation in some cases.

5. Its successful and safe employment depends upon an apparatus capable of inflating the lungs with oxygen should the patient be crowded intentionally or accidentally into spastic apnea. It depends also upon an accurate interpretation of the signs of anesthesia, but disregarding the pres-

ence or absence of cyanosis as an anesthetic sign.

6. Secondary saturation is followed by no post-anesthetic sequelae—which are detrimental or which may be attributed to its use. I believe it is safer for the patient than an ether sequence or combined gas-oxygen—ether mixture and convalescence is decidedly better when even the small amount of combined ether is avoided in the narcosis.

2233 ASHLAND AVE.

RELAXANTS IN NITROUS OXID-OXYGEN ANESTHESIA.*

ANSELL M. CAINE, M.D.
NEW ORLEANS, LA.

Nitrous oxid-oxygen would be the anesthetic of choice in most cases when there is a run down condition due to sepsis or other trouble; when there is a toxic condition due to absorption of bile from common duct obstruction; when kidney lesions are present, and when any other of the vital organs is involved with the exception of the heart, were it possible to always get good relaxation. Most cases are relaxed sufficiently with gas-oxygen alone where the operation is on the neck, breasts, extremities, face, vagina and superficial lesions, but for abdominal cases it is in the experience of the writer, practically impossible to get good relaxation without the assistance of other agents. It is true that what is sufficient relaxation for a surgeon who is used to operating under gas-oxygen anesthesia is insufficient for another who is used to the profound anesthesia of ether. The anesthetist has both these classes of operators to deal with, but the latter class far predominates.

The problem of overcoming this objection to what otherwise is, in many respects, rather an ideal anesthetic agent, has engaged the attention of anesthetists for some time. If the rigidity is due to too little oxygen, or too much oxygen the remedy is easily and quickly applied by increasing or diminishing the percentage. Slight positive pressure assists to some extent in deepening the narcosis, but this raises the blood pressure and is objectionable from that standpoint.

Warming the gases to body temperature helps also to deepen the anesthesia by causing the blood to take up the anesthetic agent more rapidly.

Preliminary hypodermic injection of morphin and atropin is of great help as it serves the double purpose of quieting the patient and thus assisting by causing better respiration, and by diminishing the troublesome flow of mucus.

Local injection of novocain along the line of incision in the skin, facia and muscle is probably the best thing mentioned thus far to secure relaxation. It eliminates the impulses going to the brain from stimulation due to traction on the muscles.

But even with all these aids, and all of them help to some extent, still there is a lack that has to be filled by some one or more of the more profound agents at our disposal. The one in most common use is ether. It does the work too, but sometimes we use more than we want to use in order to secure results, and as a consequence, the patient is upset almost as much as if we had not used gas at all. Even at that however, less ether is used than otherwise would have been used, and there is a corresponding reduction in damage to the kidneys.

CHLOROFORM AS A RELAXANT.

Chloroform has been used by the writer a great many times for this purpose. It does the work too, but acts rather slowly and is prone to give rigidity before relaxation sets in. Then too unless it is given very slowly, spasm of the larynx occurs and gives a great deal of trouble to the patient, to say nothing of heart failure and grey hairs to the anesthetist. Furthermore each apparatus must be tested as to the maximum dosage at the average flow of gas that it picks up on its way to the bag, and the anesthetist must keep well within the safety limits. This is a disadvantage to all apparatuses that have the warming device on the proximal side of the ether attachment. In that case one never knows just how much of the ether, chloroform or anesthol, that is picked up, as the temperature varies. For that reason I have eliminated the warming attachment that comes with my apparatus, and have placed another between the ether attachment and the bag. This gives a more or less uniform temperature to the gas when it passes through the ether attachment, and warms it for the patient afterwards. In hospital work where a truck and large cylinders are used, an additional stand can be attached to the truck, and on this an ether bottle, an aspirating pump and bottle, and a box for the anesthetists accessory equipment can be attached. Chloroform may be placed in the original bottle and ether in the bottle on the stand. By this means the gas and oxygen may be given alone, with chloroform, ether or with both. At the same time the aspirating apparatus is available either for the anesthetist or for the surgeon. This platform with attachments is easy to attach and is not in the way, resting as it does beneath the gas-

* Read during the Eighth Annual Meeting of the American Association of Anesthetists, Hotel Grunewald, New Orleans, April 26-27, 1920.

oxygen apparatus. This accessory ether bottle makes it very simple to administer ether-oxygen in sequence to gas-oxygen.

THE USE OF ANESTHOL.

Another agent, or combination of agents, I have been using with satisfaction is anesthol. This has an advantage over chloroform in that it acts quicker and, I believe, is safer. It relaxes better, too, in my experience. The depressing action of the chloroform and ethyl chlorid is more or less counteracted by the stimulating action of the ether. It is not unpleasant, and is easily prepared by the anesthetist. Only a small quantity is necessary as a rule, as it does not have to be given over an extended period. In those cases that seem inclined not to relax and the surgeon is having trouble with abdominal contents that obstructs his work, we do not hesitate to switch to ether-oxygen, supplementing it, if necessary with the anesthol, believing that less damage is done with good relaxation under ether and gentle manipulation of the gut, than with poor relaxation with gas and undue handling of the intestines. In the change to ether-oxygen we use the closed mask if everything goes well, otherwise we connect the simple open mask of Gwathmey. What was a difficult case often becomes an easy case when this is done, and the after effects are reduced to a minimum. We find that 6 per cent. by volume usually is sufficient to relax, and we have never given over 8 per cent. and that for only a very short time.

1640 ROBERT ST.

THE FOLLOWING IS THE MOTTO OF THE INTERSTATE ANESTHETISTS FOR 1920:

"THE ESSENTIALS FOR SUCCESS IN THE PRACTICE OF ANESTHESIA ARE PERSONALITY, ABILITY AND EQUIPMENT. NO ANESTHETIST EVER MAKES A REAL SUCCESS OF THE SPECIALTY WITHOUT CONVINCING PATIENTS OF AN INHERENT DESIRE TO TRULY SERVE THEM. PERSONALITY CANNOT BE EXPRESSED IN MERE WORDS; IT MUST SHINE FORTH IN THE STERLING CHARACTER OF THE ANESTHETIST AND MUST EVIDENCE ITSELF IN EVERY ACTION IN BEHALF OF SUFFERING HUMANITY. THE MEASURE OF THE ANESTHETIST'S ABILITY DEPENDS UPON ADEQUATE EDUCATION, NATURAL ENDOWMENTS, AN APTITUDE FOR THE SPECIALTY AND CONSCIENTIOUS WORK. ABILITY NOT ABOVE THE AVERAGE AND LEFT UNDEVELOPED EVENTUALLY FAILS OF ACHIEVEMENT. NO ANESTHETIST WITH THE PRIDE OF ABILITY OR THE DESIRE FOR EXCEPTIONAL SERVICE WILL HANDICAP SUCCESS BY FAILING TO PROVIDE ALL THE LATEST AND BEST EQUIPMENT FOR THE PRACTICE OF THE SPECIALTY. THIS IS NOT MERELY A PRIVILEGE BUT A DUTY."

THE OPEN METHOD OF NITROUS OXID-OXYGEN ANESTHESIA.*

JAMES T. GWATHMEY, M.D.,
NEW YORK CITY.

The method is called *open* in contradistinction to the face mask and rubber bag method usually employed in administering nitrous-oxid and oxygen and in which air is excluded as far as possible. The *open method* referred to in this paper is the equivalent of the drop method of ether, the mask of which is usually so covered with towels that it is hard for an onlooker to understand why the term *open* is used in connection with it. My mask is also covered with towels, nevertheless the method seems to offer certain advantages over the usual closed method, and for this reason I decided to submit it to the Association at this time. It is not intended to take the place of the usual method of employing nitrous oxid and oxygen, but is offered as a substitute for the *open-drop* or any other method of administering ether, and also as an aid in enesthetizing certain patients to whom the closed method seems a burden.

A mask is used just twice the size of the Mayo ether mask, and is sufficiently large to hold a full inspiration of an adult. With a larger mask it might be possible to fully anesthetize a patient with the gases alone, although this is not desirable, if our theory of narcosis is correct. The open method may be used with any gas-oxygen machine, as all machines have attachments in which may be placed the additional medication needed with the open method. The technic will be described as employed with the Gwathmey apparatus.

ADMINISTRATIVE TECHNIC.

The technic about to be described presupposes preliminary medication of some kind.

The mask, upon which has been placed several layers of gauze, scented with the essence of orange or oil of bitter orange peel, is placed in position and the patient told to breathe through the mouth, if possible, but in an easy and natural way. Under no circumstances should straps or holding bands be placed on the patient, either at this or any other time. If any sensory reflexes get through to the brain, requiring restraint, then we have not a true anesthesia, and the sooner we drop the agent or technic that requires this additional help and have our inhalation anesthesias approach the same perfection that is attained with good local or spinal anal-

*Read during the Eighth Annual Meeting of the American Association of Anesthetists, Hotel Grunewald, New Orleans, April 26-27, 1920.

gesia, the better it will be for our patients and ourselves.

The objects of all methods of anesthesia, whether local, regional or general, is to isolate the brain during the operation, and to leave the patient in such condition that little or no reaction is possible afterward.

The anesthetic is started with three holes of nitrous oxid and one of oxygen; in ten or fifteen seconds the anesthol valve is turned slightly, just enough to have the gases barely bubble through, and from this on it is very gradually increased until there is a slight bead on top of the liquid; time, one minute to a minute and one-half. The patient is now unconscious but not anesthetized. The technic from this on will vary with the substances to be used in connection with the nitrous oxid and oxygen. If only nitrous oxid-oxygen and anesthol are to be used, the anesthol is turned on just a little more until the breathing of the patient is automatic, when it is turned back to the second position. The oxygen valve is now turned to the second hole and the oxygen and nitrous oxid remain thus proportioned throughout the operation, the depth of anesthesia being regulated by the anesthol. Toward the close of the operation the anesthol is turned off, and it will be found that the patient will be very easily kept under with the gases alone. Finally, the nitrous oxid is turned off and the oxygen alone allowed to run for two or three minutes through the third and fourth holes, but not until the patient is entirely conscious. The mask is now removed, and within a few minutes the patient can answer questions intelligently, but is best left undisturbed to sleep through the pain zone, which usually lasts from one to two hours. The return of the brain to its usual activity is as if from a quiet night's rest and with no reaction afterwards.

VARIATIONS IN TECHNIC.

The method just described is the simplest, and the management of the gases is the same throughout, but the technic may vary considerably as follows:

If the second container holds ether, this valve is turned on slightly as the patient becomes unconscious, or at the end of a minute and one-half. If the swallowing reflex asserts itself, it is turned off again, and this movement is repeated until there is no swallowing reflex when the ether is allowed to remain on. The anesthol may be turned off at this time, and gas-oxygen-ether used throughout, or gas-oxygen-anesthol and ether. If, instead of ether, the second container holds three to four drams of paraldehyde, this valve may be turned on gradually to full at the end of a minute and a half and the anesthol turned off. The nitrous oxid-oxygen is allowed to blow over the top of the paraldehyde. If the narcosis becomes too light, the nitrous oxid may be increased for a short time, or the anesthol may be turned on again, the narcosis being easily regulated in either of these ways. With any of these methods, the patient's transition from consciousness to full surgical anesthesia is smooth and tranquil and the stage of excitement or struggling is omitted. The time required to reach full surgical anesthesia is from three to five minutes.

Paraldehyde combines very readily with nitrous oxid and oxygen, and while small amounts not over one dram per hour are taken up when used as described above, this small amount makes an appreciable difference in the perfection of the anesthetic and in the comfort of the patient afterwards. With any of the technics described, the patient is fully oxygenated at all times, has a pink color from start to finish, and blood pressure is even.

The theory upon which this special form of anesthesia depends, is based upon the fact that each of the agents used affect the nervous mechanism in a different place and in a different way with a resultant anesthesia that is more nearly perfect than if any one agent is used.

THE VALUE OF THIS METHOD IN DENTISTRY.

It seems, from clinical experience, that the brain is better protected from shock or sensory impulses when a number of narcotics and anesthetics are used, than when some single agent is employed. The following data would seem to prove this hypothesis. A certain dental specialist in New York City, who has extracted over 80,000 teeth during his professional career, at my suggestion uses a 50 per cent. mixture of paraldehyde and anesthol in connection with his nitrous oxid and oxygen, merely passing the nitrous oxid and oxygen over this mixture. Each patient gets in addition to the nitrous oxid and oxygen approximately 00 drops of paraldehyde, 00 drops of chloroform, 00 drops of ethyl chlorid and 00 drops of ether. This estimate is based upon the supposition that *anesthol* is what it is claimed to be, that it combines in stable chemical union 35.89 per cent. of chloroform, 17 per cent. of ethyl chlorid and 47.10 per cent. of ether, with a boiling point of 40° C. (104° F.). The usual time of administration is one and a half minutes, with a resultant anesthesia so perfect that this dentist has one and a half minutes in which to do his work. Where formerly a large circingle was used for certain classes of patients, athletes and alcoholics, for the protection of both patient and

dentist, this has now been discarded and is never used. Not only is the resultant anesthesia more perfect than when the gases are used alone, but the patients leave the chair and walk from the room usually unassisted and without nausea, headache or vomiting. This dentist states that under no consideration would he go back to the old method of using the gases alone. The new method is not only better for the patients, but this operator states that he himself walks from his office after a hard's day's work feeling entirely different from the bedraggled condition in which he formerly lived.

The clinical experience of one with 80,000 cases to his credit cannot be discarded lightly. I have seen a traffic cop, an athlete in the pink of condition, anesthetized in this dentist's office as easily as an obedient and submissive child. On the other hand, I witnessed a sailor come in to another clinic where only gas and oxygen is used. This patient was strapped down in the usual way and additionally several volunteer aides assisted in the holding. When the extraction finally occurred, there was no question about the brain being unprotected, and the seas were rolling high when he was escorted from the room. And yet I have never seen nitrous oxid and oxygen more carefully and evenly given, nor with better results, in the usual run of cases than in this very clinic. The sailor was, of course, an exceptional case; so was the policeman.

These illustrative cases are given, not to compare one clinic to another, but to compare the administration of nitrous oxid and oxygen alone, and also when administered with a number of drugs. We have the comparison not only of the two clinics, but of the same operator using the two systems. The *clinical* test is the final one and the above data to me is conclusive. It makes no difference whether the agents used are given preliminarily or at the same time, or both preliminarily and at the same time—the results are the same provided, of course, that you get the full physiological effect of the drugs used.

ILLUSTRATIVE CASE REPORTS.

Only recently I had four prostatectomies in patients between forty and sixty years of age. Each patient received preliminarily fifteen grains of chloretone by mouth, one hour before, and one-quarter grain of morphin and 1/150 of atropin forty minutes before operation. Operations averaged one hour each.

Gas-oxygen-anesthol or gas-oxygen-paraldehyde and anesthol open method, were used. One ounce of anesthol per hour and three-quarters of a dram of paraldehyde were the amounts given.

Patients were perfectly relaxed throughout, but were entirely conscious before leaving the operating room. None of them were sick in the slightest degree or showed any untoward reaction whatever. Most of them dozed for several hours afterward. A child four years old was anesthetized by this method for one hour, for a cystosopy. It was perfectly quiet during this time, but slept for twenty minutes after the anesthetic was discontinued, and then awoke in a perfectly normal condition. The same child had a kidney removed one month later under the same anesthetic technic, with resultant perfect anesthesia and with no reaction whatever afterwards. Gas-oxygen and anesthol was used—about ½ ounce of anesthol per hour.

OBJECTS AND ADVANTAGES.

The open method of nitrous oxid-oxygen-ether or nitrous oxid-oxygen-anesthol-ether can be used wherever oxygen-ether has been used in the past. Dr. Lumbard, who uses oxygen-ether quite extensively, states that the average amount used with this method is three and one-half ounces per hour. Dr. J. C. Gates, of New York City, states that the average amount used with this method is one ounce of ether per hour in addition to the anesthol required in the induction. The principal objects in using this method is to abolish respiratory difficulties during operation by obtaining more complete relaxation than is usual with any closed method and at the same time reduce to a minimum the disagreeable after effects obtained with ether as usually administered. These objects have been, in a very great measure, realized—but the last word has not by any means been spoken either on this particular technic or on any other method or agent used. This method is merely offered as a simple, safe and efficient way or hypnotic for those who have not had the technical training necessary for the closed method, or for those who wish to improve their technic in administering ether, or who wish to test in a perfectly safe or sane way the theory annunciated in this paper, that is a combination of narcotics and anesthetics isolates the brain from reflex stimuli more thoroughly than any other method of general inhalation anesthesia now in common use.

40 EAST 41ST ST.

THE VARIOUS ASSOCIATIONS OF ANESTHETISTS ARE TRYING TO SECURE A SECTION ON ANESTHESIA IN THE A. M. A. DO YOUR BEST TO HAVE YOUR STATE MEDICAL SOCIETY ENDORSE THIS MOVEMENT AND INSTRUCT ITS DELEGATES TO VOTE FOR SUCH A SECTION AT THE BOSTON MEETING, JUNE 6-10, 1921.

ANESTHESIA IN WAR SURGERY

ETHYL CHLORID GENERAL ANESTHESIA FOR WAR SURGERY.

LUIGI CAFORIO, M.D.,
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I do not make any claim, in this publication, to any new discovery. My object is to cooperate in the improvement of an anesthesia, which has heretofore not attracted the attention it deserves, and to set forth the results of my personal experience in the field of ethyl chlorid narcosis. From the results of my own experience I am convinced that if ethyl chlorid general anesthesia were more largely employed, many advantages would accrue to surgery in general and to war surgery in particular.

I am surprised to find that while kelene general anesthesia has been resorted to systematically for many years past abroad, and especially in America, in ordinary surgical operations, in Italy few surgeons have given any attention to it while many of the profession do not even know of its existence. I am still more surprised when I note how eminent surgeons and skilled practitioners, to whom I have shown the practical advantages of this method on the operating table, have neglected to adopt the same, in spite of the fact that they have acknowledged its advantages and its usefulness.

This negative attitude is absolutely unjustified especially in view of the fact that all books published on this matter during the last 30 years show an almost unanimous consensus of opinion in favor of kelene anesthesia, which does not present any greater risks or dangers than those presented by other anesthetics in general use, such as chloroform and ether.

HISTORICAL CONSIDERATIONS.

It is needless to survey the entire history and the different phases of general anesthesia by means of ethyl chlorid. A very detailed report on this process is to be found in the standard work of Girard (*Revue de Chirurgie*, 1902), to which I refer the reader. I shall simply say that the original observations of Richardson (*Medical Times and Gaz.*, 1877), of Steffen (*Brit. Medical Journal*, 1918), of Dujardin-Beaumetz (*Diction de Terap.*, t. II, p. 574, 1885), of Carlson (*Zahnarzliches Wochenblatt*, 1895), of Billeter (*Shw. Vierteljahr. f. Zahn*, 1897) and the even more detailed observation of Von Hacker (*Beitr. f. Klin, Chirurg.*, 1898), of Wiesner (*Wienmedizinische Woch.*) of Polloson (*Province Medicale*, 1900), of Tuttle (*New York County Med. Associat.*, 1900) not to mention other authors, have concordantly borne out the great practical value and the efficiency of general kelene anesthesia. Since 1900, observations have become more and more numerous and ethyl chlorid narcosis, at least in foreign clinics, has been a routine method of narcosis in short operations.

Nougue (*Arch. de Stomatol*, 1901) recommends this method in first aid surgical operations: Doyen (*Revue critique de medicine*, 1901) advises its use in field surgery; Fromaget (*Presse Medicale*, 1901) publishes 100 cases of perfect application of kelene anesthesia in eye operations; Malherbe (*Nuova Riv. clin. terap. anno V.*), publishes 140 cases, Guinard (*Bull. et Hem, de la Soc. de Chir.*, 1902) announces that he is going to resort exclusively to anesthesia by the inhalation of ethyl chlorid.

In Italy Schifone (*Policl. Sez. Chir.*, 1904) and afterwards Cassanello (*Arch. ed atti della Soc. Ital. di Chir.*, 1905) set forth the harmlessness and the unobjectionableness of kelene anesthesia. Thereafter the endorsers increased year by year so that it was very difficult to refer even in a superficial manner to the works and treatises published in the last 30 years.

ETHYL CHLORID IN WAR SURGERY.

I refer to the most important works published in this connection only to show again that in view of the general adoption of ethyl chlorid inhalations, in view of the safety and good results of this method, and of the advantages it offers, it is now time for it to be introduced in Italy, especially in war surgery which calls for quick, short, speedy operations which very often cannot be preceded by a preparatory period for the administering of the anesthesia and which are most of the time to be performed without the help of the complicated equipment intended as a safeguard against possible contingencies.

One should remember that kelene anesthesia is brought on in a few moments and that it disappears with like speed, the patient recovering without external stimulant. One should remember that this anesthesia, due to its swiftness and to the absence of untoward complications, may be resorted to by any physician unskilled in the administration of anesthetics. One should consider that upon his awak-

ening, the patient is not troubled by nausea, vomiting, headaches, dizziness, so that it is possible to apply this narcosis even without the usual preparation of cathartics and fasting, and that the patient can, after the anesthesia, take without danger his ordinary food, which facilitates the hospital service. Taking into account all these special advantages one cannot fail to appreciate the actual merits of this method of anesthesia.

SCOPE AND UTILITY.

Due to the short action, one cannot advise this method of anesthesia for complicated and long operations, but whenever we are called upon to perform operations of ordinary surgery, such as incisions of phlegmons, abscesses, honeycomb ringworm tumors, removal of cysts and other superficial tumors of the skins, crushing of amygdala, removal of ingrown nails, etc., what shall we do? Is it not true that in war surgery we very often are called upon to perform operations for the extraction of splinters and projectiles, for straightening stumps, for small amputations, for treating open wounds, for setting fractures, etc.? What are we wont to do in such cases? Either we have recourse to chloroform with the attending inconvenience to the hospital service, or we have recourse to local anesthesia by means of ethyl chlorid which is an absolutely inadequate anesthesia, far from solving the problem.

In these cases I believe it to be the duty of the surgeon to take advantage of the precious aid afforded by the inhalation of ethyl chlorid.

The inhalations should be continued to surgical narcosis, in order to obtain the most complete results. For this purpose there have been suggested numerous appliances and arrangements such as the special masks of Billeter and of Brodtbeck, of v. Hacker, of Koenig, of Dumont-Doyen, of Pollosson, and of Mirschler. Without resorting to such helps, I have used with good results the small ordinary mask of Esmarch, duly modified, and I have not recorded a single failure.

METHOD OF ADMINISTRATION.

In the middle of a square piece of waterproof cloth (25 cm. side) I make a hole having the size of a two-cent coin and I introduce into the hole a small ball of cotton or gauze. I place the waterproof cloth on the Esmarch mask in such a way as upon the mask being placed on the patient's face, the latter cannot but breath through the cotton ball. Strictly speaking, one might dispense with the Esmarch mask and directly apply oilcloth on the face, but the direct contact of liquid ethyl chlorid with the lips and the nostrils is painful and irritating. Before applying the mask I pour on the small cotton ball the contents of one-half phial of kelene and when the ball appears entirely covered with icicles and sufficiently impregnated with the anesthetic, I apply the mask on the face of the patient, seeing to it that the margins of the oilcloth projecting from the Esmarch cage are properly fitted on the contour of the face. I ask the patient to inhale deeply while I continue to direct a thin stream of ethyl chlorid on the cotton ball. Narcosis is a question of a few seconds. Sometimes the patient falls asleep immediately; sometimes he is agitated for 5 or 10 seconds; then narcosis sets in. The face is slightly overflushed; the breathing is deep and quiet; the pulse is rythmic and full. The pupil is only slightly midriatic (dilated). The muscular relaxation is complete; the reflexes are abolished. On an average it is sufficient to administer from 1 to 3 cm. per minute in order to obtain a perfect and lasting anesthesia without any untoward occurrence and without the smallest alarm.

If mydriosis (pupil dilation) were to become accentuated, the inhalations should be suspended (*Phocas. Therap. chirurgicale et clinique journaliere,* 1901). I say if it were to become pronounced because in all the numerous ethyl chlorid anesthesias I have practised I have never had to suspend the inhalations due to any unfavorable symptoms.

RECOVERY.

After the surgical operation is terminated, the mask is removed and the patient, in a period ranging from 10 seconds to 30 seconds, awakens, generally all of a sudden, as if he was awakening from natural sleep and it looks as if intoxicated. He is smiling, loquacious, playful and happy. His ideas are still confused and rather disconnected. A minute more and he has completely recovered without a single inconvenience, without any discomfort. He can raise himself, walk and attend to his customary pursuits, but it is my custom to keep patients in bed for at least two hours as a precaution.

It happens sometimes, but rather seldom, that patients do not lose consciousness entirely during the narcosis, but continues during the entire time to grumble words, to argue, to sing in a state of drowsiness, the substance of their ejaculations being very hilarious and pleasant. Upon their awaking the patients have no recollection of what has happened, or at the most, a twilight recollection.

POSTOPERATIVE EFFECTS.

It has been maintained that ethyl chlorid exercises an influence on the heart, the kidneys and on the hepatic cell. Jacobin (*Progres medical Belge,*

1901) points to the possibility of gastro-intestinal troubles as its aftermath. There is no doubt that like all anesthetics in general, this anesthetic, too, may react unfavorably, especially if the inhalation lasts for a long time, on the action of the heart and on the action of the emunctory organs, but these dangers are absolutely like those encountered when other anesthesias are resorted to. We can even state that since the action of the ethyl chlorid is characterized by its transiency, it is clear that this anesthetic should prove less injurious than the other anesthetics. Furthermore, taking into consideration the fact that in war surgery the patients operated upon are strong and healthy young men, no importance should be attached to the objection thus raised, so that Wiesner prefers kelene to ether and to chloroform even for long operations, and Severeanue (*XIII. Congr. Internaz. de Med. Chir. Gen. Paris,* 1900) declares that he is thoroughly convinced of the harmlessness of ethyl chlorid. Similar conclusions have been reached by means of the experimental researches carried out by Flourens (1851) on dogs; by Wood, Cerna (1892) and Ruegg (1898) on rabbits and dogs; by Koenig (1900) on rabbits and monkeys; by Lebst (1900) on frogs and rabbits; and by Girard (1902) on cats, dogs, rabbits, rats and guinea pigs.

Cassanello states that he has never discovered any injurious effects on the kidneys, even in the case of patients suffering from kidney disease.

More numerous are the observations made by Girard. The latter, in a total of 2,000 cases of general ethyl chlorid anesthesia has not had to record a single death, and he is thereby led to make the statement that neither age nor sex, nor the seriousness of the disease, nor alcoholic intoxications, but only the condition of the kidneys may contraindicate the use of kelene.

As far as I am concerned, both on the firing line and in my present service, I have adopted the routine use of ethyl chlorid anesthesia in short operations. I have resorted to it in more than 500 cases and never in a single case have I had to repent of having done so, but invariably I have been led to place still greater confidence in the method, and this enthusiasm of mine for ethyl chlorid narcosis is shared by the very patients in my district. Now the patients themselves request me to resort to this anesthesia for the operation I have to perform on them. They advance this request after they have witnessed the results obtained on their fellow-patients and they are keen in advising their friends, about to submit to an operation, to have the operator resort to this kind of anesthesia.

As I have stated above, I have never had to record the slightest unfavorable occurrence. I have not had a single case where the narcosis proved either a total or even a partial failure.

Out of 100 cases, where in order to watch the operation of the kidneys I have carried out before and after the operation an examination of urine, only in two cases have I noticed a slight transitory albuminuria, and even in five cases in which the function of the kidneys before the narcosis appeared slightly abnormal, I failed to notice any change for the worse in the condition of the kidneys, according to the observations made by Cassanello.

If this short communication of mine will lead other surgeons to routinely employ ethyl chlorid anesthesia I shall feel satisfied that I have done something to better both the surgery of war and of civil life.

INDUCTION OF ANESTHESIA AND ANALGESIA BY ORAL ADMINISTRATION OF VARIOUS DRUGS WITH A REPORT OF CASES.*

A. FICKLEN, M.D.,
NEW ORLEANS, LA.

The problem of dressing extensive wounds has always presented difficulties to the surgeon. He must be thorough, but he hesitates to inflict great pain on the patient. Morphin, ether, chloroform and nitrous oxid have all been used to lessen the ordeal, but each has its disadvantages. Morphin is not sufficient; ether by inhalation causes nausea and is regarded with dread by most patients who have taken it before; chloroform is dangerous. Nitrous oxid is best, but is not always available.

During the recent war I saw dressing after dressing in which the surgeon took advantage of the stoicism of the soldier and inflicted pain that could have and should have been avoided. The removal of packs, the changing of splints, the manipulation of infected joints:—the wounded man feared these more than he had feared the charge of the enemy. When the intoxication of battle had passed, gentleness in handling the casualties became more necessary than ever, but care, hypodermics, and irrigation of bandages beforehand all failed only too often. For this reason I welcomed an article which appeared in the May number of the bulletin of the American Red Cross, on analgesia by oral administration. I found later that this was condensed from a report in the *British Medical Jour-*

*Read before the American Association of Anesthetists, during the Eighth Annual Meeting, Hotel Grunewald, New Orleans, April 26-27, 1920.

nal of March 2, 1918, by Dr. James T. Gwathmey of New York, and Dr. Howard Karsner of Cleveland. The *Journal of the A. M. A.* of April 6, 1918, also prints this most interesting analysis of experiments on animals, and results in clinical cases.

EXPERIMENTAL DATA.

As this is primarily a summary of experiences with the method I will not go deeply into the animal experiments. Suffice it to say that various drugs were given to rabbits by stomach tube and that 50 per cent. ether in olive oil was found to produce the desired effect. The olive oil, however, caused an acute gastritis in rabbits, so liquid petrolatum or Russian mineral oil was substituted. Quinine and urea hydrochloride, trional, morphin tartrate, and paraldehyde were all tested, but the results did not warrant use in man. The fact that ether drinkers suffer no more than alcoholics from gastric irritation and that "a 65 per cent. solution of ether in oil has been used in many thousands of cases of ether-oil colonic anesthesia without any signs of local irritation to rectum or colon" reassured the authors.

The following formulas were used clinically:

Formula 1—Ether 4 fluid drams,
Liquid Petrolatum 4 fluid drams,
Peppermint water 5 minims.

Formula 2—Paraldehyde 1 to 3 fluid drams,
Ether and liquid petrolatum equal parts to make 1 ounce,
Peppermint water 5 minims.

Formula 3—Ether 3½ fluid drams,
Liquid Petrolatum 4 fluid drams,
Peppermint water 5 minims.

Formula 4—Chloroform ½ to 1 fluid drams,
Ether 3½ fluid drams,
Liquid Petrolatum 3½ fluid drams,
Peppermint water 5 minims.

METHOD OF ADMINISTRATION.

The authors recommend, at the suggestion of Major Lower, that port wine be given before and after the dose. They state that rinsing the mouth thoroughly with the wine disguises the taste of the drug effectively. Our medical supplies did not include port, so I substituted undiluted whiskey. Probably yerba santa could be used to better advantage. The taste of Formula 4, as I know from experience, while pungent, is not as unpleasant as that of castor oil.

Approximately sixteen cases are reported in most of which ether liquid petrolatum was given. One vomited, three fell into a light sleep. The administration of a half dose gave unsatisfactory results. Extensive dressings were done without pain, the patients had no headache and woke with good appetites. The authors also mentioned that Formula 4 was given in approximately thirty cases, and that it is a more satisfactory mixture than the others. Detailed case reports, however, are not presented.

Ether-oil by mouth was also used as a supplement to chloroform anesthesia. An extensive operation on the knee joint was performed in this way with the use of only two drams of chloroform.

Since the literature on this subject is so scanty at present, I wrote to Dr. Gwathmey asking if his subsequent experiences had caused him to modify his opinion in any way. I quote from his reply:

"In addition to the inclosed (a reprint from the *British Medical Journal)* I finally used this formula quite frequently:

Chloroform drams 2,
Ether drams 2,
Liquid paraffin 4 to 6 drams,
Peppermint water 5 minims.

If the dressing was very painful I used in connection with this morphin sulphate, grain ¼ to ⅜, by hypo, one-half to three-fourth hours before. With this combination there was no question about the analgesia. Operations with this combination were not entirely successful. I may add that three of the officers and myself took Formula 1 immediately after a very hearty meal, and as a liqueur, and with no bad effects whatever . . . . and with analgesia, so it seemed to us."

Gwathmey's recent experiments have demonstrated that chloroform given by mouth has dangers. Until his report appears I am not at liberty to go into details.

CLINICAL PHENOMENA.

Approximately half of the patients had a short stage of excitement manifested by restless movements and loud talking. This lasted from three to five minutes and was succeeded by deep sleep and complete muscular relaxation. The pulse was full and bounding and ranged from 80 to 100. Many of the patients fell asleep in five minutes and did not rouse for several hours. The face was slightly flushed or normal in color. Dressing was started in from 5 to 25 minutes. In about one-third of the cases the breathing was deep and stertorous, in the rest it was slow and regular but not snoring. Two of forty personal cases did not sleep but had pronounced analgesia. On questioning these two the next day I found that they had little recollection of pain. This is parallel to

the loss of memory following morphin-scopolamin administration. In particularly extensive wounds and twenty minutes before operation, I gave a hypodermic of morphin, grain 1/6. This is a useful adjuvant but is not absolutely necessary. Gwathmey and Karsner state that their patients fell into a light sleep. Most of my cases slept profoundly and many of them gave absolutely no signs of pain during the removal of tight packs or the changing of splints. This is due to the fact that I used the following prescription, taken from the American Red Cross bulletin:

Formula 5—Chloroform 5 c. c.
Ether and Liquid petrolatum, each 20 c. c.

With this prescription, which is obviously more powerful than ether-oil, I estimated that the maximum effects lasted from one-half to three-fourths of an hour. After an hour the patient rouses easily. Groaning was noted occasionally but had no significance. I did not test the total duration of analgesia, which probably persisted from some time after the anesthesia had worn off. Most cases slept for two or three hours and one as long as five hours. All were drowsy even though they were able to answer questions. Four or five complained of the taste of the mixture but were willing to take it again for its effect. This is the usual attitude of human beings towards intoxicants.

CASE REPORTS.

The following case reports will give a more vivid idea of the results obtained:

CASE 1.—S. C., aged 23, weight approximately 150 lbs., gunshot wound, high explosive, right frontal and parietal region, extensive comminution skull, loss of brain substance and avulsion eye-ball. Debridement and packing extending deep into cranial cavity. Oral anesthesia third day. Five minutes after administration patient made a few restless motions and breathing became stertorous. He did not respond to questions. The bandages were cut and the edge of the pack cautiously retracted. The patient did not move. This was my initial case and I proceeded cautiously at first, but grew bolder as I approached the depths of the wound. The pack was removed, fresh gauze placed in the orbit and into the gaping cavity in the skull. The patient showed absolutely no signs of discomfort. He slept all the rest of the afternoon, about three hours, and had to be awakened for supper. Two days later the dressing was repeated with the same technic and the same result. He was then evacuated but I was fortunate enough to see him up and around six weeks later at Base Hospital 24.

CASE 2.—J. D., aged 24, weight 145, hemolytic streptococcus infection left knee following injury in R. R. accident. Dressings in this case necessitated flexion of the joint and were extremely painful. Oral anesthesia was used on seven different occasions. Unconsciousness always followed within 15 minutes. Drains were removed, splints changed and new tubes inserted with no sensation on the part of the patient. There were no after effects whatever. The patient asked for the mixture. He remained six weeks in the hospital and was evacuated much improved. The septic process had been arrested and he had gained materially in weight. This case shows that the ether and chloroform mixture may be given repeatedly without deleterious effects.

CASE 3.—H. G., aged 20, weight 130, intensely nervous, circular amputation upper third leg for mixed infection hemolytic streptococcus and B. Welchii, cuff of skin turned up, flaps left unsutured, oral anesthesia, third day after operation. Patient groaned and complained in a low voice during dressings, answers to questions were vague. Had almost no memory of dressings and no recollections of pain afterwards. This case hovered on the border line between analgesia and anesthesia.

The following case shows the advantage of ether chloroform by mouth as a supplement to ether by inhalation:

CASE 4.—P. G., aged 20, weight approximately 120, gun-shot wound, right ankle, hemolytic streptococcus infection, compound comminuted fracture tarsus, amputation decided on in consultation with the chief of surgical service. Oral anesthesia in ward. After 15 minutes patient carried to operating room, splint removed, leg shaved and washed thoroughly. Patient slept tranquilly. Ether drop method started during applications of iodin and incision made after a few c. c. had been poured on mask. A modified circular amputation was done with suture of the flaps. At the conclusion of operation it was found that only 90 grams of ether had been used. The patient did not vomit and slept for three hours afterwards.

CASE 5.—One-half the normal dose was given to this patient. He entered the hospital profoundly septic. His weight was about 70 lbs, and recovery was obviously impossible. He complained bitterly during the dressing, was wide awake and seemed to have no analgesia whatever. He slept for two hours afterwards and did not vomit. 10 c. c. of ether and 2½ c. c. of chloroform was apparently too little.

CASE 6.—S. G., aged 21, weight approximately 100. Empyema following pneumonia. General condition bad. Ether-chloroform given on operating table. Asleep in 10 minutes. Two syringefuls ¼ per cent. novocain injected into chest wall. Resection one inch 5th rib mid-axillary line. Patient did not complain but coughed when pleura was opened. Drainage tubes inserted, binder applied, and patient returned to ward sleeping. Apparently little shock.

The above illustrate the different types of reaction to the drugs. One case vomited almost immediately after swallowing the mixture, and Dr. Philip Carter reported a similar occurrence. The undiluted whiskey was perhaps to blame. Dr. Lacroix used the method on four or five patients with most satisfactory results.

ADDITIONAL CASE REPORTS AND CONCLUSIONS.

Since my preliminary report to the Orleans Parish Medical Society, I have been able to collect several cases from the practice of my confreres and myself in which this analgesia has been used. As most of them only bear out the conclusions already reached, it will not be necessary to report them in detail. Two of the cases differ from the other enough to deserve mention.

CASE 7.—In the first, a boy of 14 years, weight about 90 pounds, was skin grafted over an area approximately three by four inches and there were absolutely no pain sensations. The analgesia lasted for an hour, and anesthesia the same length of time. As soon as the skin grafting was finished a stomach tube was passed and the gastric contents withdrawn. A distinct film of the oil, smelling strongly of ether, appeared in the pan showing that total absorption had not taken place in three-quarters of an hour. Washing out the stomach evidently shortened the analgesia considerably. He was not nauseated but had a slight headache; there were no changes in the urine.

CASE 8.—Another boy, aged 12, was given the full dose for an adult. An oblique fracture of the tibia was reduced as easily as though he had taken ether by inhalation. This boy had eaten breakfast a short time before. He was quite nauseated on regaining consciousness and vomited several times that evening and that night. The analgesia increased steadily for fifteen minutes after he had fallen asleep. The pain reflexes were distinctly delayed. Analgesia lasted two hours and fifteen minutes, and anesthesia about one hour and a half.

I feel justified in presenting the following additional conclusions in regard to the administration of oil, ether and chloroform by mouth:

1. In default of Port wine, syrup of yerba santa in one dram doses disguises the taste fairly well.

2. If the body weight is less than one hundred pounds analgesia, followed by narcosis, results.

VARYING REACTIONS.

In adults, however, varying reactions are noted, ranging from slight analgesia to pronounced narcosis, but never reaching the stage of complete abolition of reflexes. The pharyngeal reflex, for instance, is always persistent. The youngest patient in my series was twelve years old. I should hesitate to give the full dose to a child of ten. Too few obstetrical cases have been observed to formulate definite conclusions, but we can undoubtedly diminish the pains of labor by the use of this method, and if the drugs are given near the conclusion of the second stage, without danger to mother or child. A preliminary purgative and an empty stomach practically eliminate nausea.

It is realized that the usual dosage of chloroform given internally, stated to be from five to ten minims, has been much exceeded. Chloroform causes a sensation of heat and burning in the stomach and is absorbed rapidly when given undiluted. Its fate in the body is unknown, except that a certain proportion is excreted unchanged by the lungs. Corner in the *Clinical Journal*, May, 1912, states "that the anesthetic in part is excreted into the alimentary canal and reabsorbed from it, therefore it matters little if the drug is swallowed or absorbed from the lungs."

Sudden death from chloroform, which is supposedly due to reflex cardiac inhibition through irritation of the trigeminal terminals in the upper respiratory passage and transmission of the impulses to the vagi, is not likely in these cases. Fear, struggling, shock, pain and extreme youth, which are regarded as being predisposing causes of the acute form of poisoning, are evidently not factors that need be considered in this connection. I watched closely for symptoms of delayed chloroform poisoning. The cerebral irritation, the waxy skin followed by jaundice, the nausea and vomiting, the fever, the pain referred to the right shoulder, the liver tenderness and the collapse which characterize this most serious complication have not resulted so far from the 5 c.c. doses administered. However, further observation is certainly necessary, as one such case would condemn the procedure and force us to use simply ether and oil.

The text book dosage of ether given as from ten to sixty minims has also been much exceeded. Nicloux has shown that in dogs the percentage of anesthetic in the blood in deep narcosis is .05 for

chloroform and .13 to .14 for ether. We may assume that the predominant symptoms in these cases are due to ether and that the chloroform simply prolongs and intensifies the ether effects. Full bounding pulse, the frequency of strong, regular respiration and the preliminary excitation are typical of ether and not of chloroform. Since the percentage of concentration determined by Nicloux would not be approached even if immediate complete absorption took place, and it has been definitely proved that it does not, we may be fairly certain that we are below the toxic limit.

Lastly, several of my colleagues have asked me how the effect of these drugs can be controlled once they have entered the stomach. Gastric lavage combined with the accepted methods of treating poisoning by anesthetics would seem the best solution. So far the entire absence of alarming symptoms has rendered such a course unnecessary.

ORAL ANALGESIA IN LABOR.

I have also been able to collect seven cases in which the ether-chloroform mixture was used in obstetrics. These cases will be reported in detail. Briefly they showed varying degrees of analgesia and light anesthesia. The mixture does not seem to diminish the contractions of the uterus, even when the patients were asleep. In my two personal cases I could see no effect on the child. In one case massage of the uterus was necessary for a slight hemorrhage, but it would be unfair to ascribe this entirely to the drugs given, as it occurs so frequently when there has been no medication. I have used the syrup of yerba santa in one dram doses and it apparently disguised the burning taste to a certain extent, but does not abolish it entirely. In one case, though a perineorraphy was not necessary, I feel sure from other tests that there was sufficient analgesia for this operation.

One case showed a pronounced stage of excitement; in two there was analgesia plus narcosis, and in the rest varying degrees of analgesia. The uterine contractions were not diminished in force or frequency. One of my patients stated that she felt complete relief from an agonizing pain in the sacral region and that the bearing down pains were much relieved. Drs. Newman and Levy are inclined to believe that administration during the first stage is advisable, but my efforts have been to diminish the suffering of the latter part of the second stage. One of Dr. Newman's case reports notes that the baby was born thoroughly anesthetized. It survived and showed no ill effects. The mixture had been given about two hours before birth.

The summary which follows represents the conclusions formed after observation of about forty-five patients. As record keeping was impossible during part of the time, I have underestimated rather than overestimated the number seen personally, judged to be forty.

SUMMARY.

Ether chloroform and liquid petrolatum when swallowed in the quantities stated produce a safe general analgesia, accompanied in nearly all cases by light anesthesia.

Vomiting occurs in a small proportion of cases.

Alarming symptoms have never been observed.

The effects of the drugs are intensified and prolonged by the administration of morphin.

The ether oil mixture is not as powerful as the formula to which chloroform has been added. This conclusion is reached by comparing the case reports of Drs. Gwathmey and Karsner with my own.

The field of usefulness of the procedure should be broadened. Enough cases have already been observed to show that it is of value in painful dressings and as a supplement to general anesthesia. It has not been used, as far as I have been able to ascertain, in gynecological examinations where relaxation is necessary, in suspected malingering, and in manipulation of ankylosed joints.

Since the method is yet in its infancy, further tests should be made to determine its status in surgery, and the above suggestions are made with this in view.

I am indebted to Dr. Gwathmey for the interest he has taken in this report.

621 MACHECA BLDG.

THE AMERICAN ASSOCIATION OF ANESTHETISTS WILL MEET IN BOSTON, JUNE 6-7, 1921, THE FIRST TWO DAYS OF A. M. A. WEEK. THIS—THE FIRST ANESTHETIC RALLY EVER HELD IN THE NORTHEAST—WILL BE THE NINTH ANNUAL MEETING OF THE ASSOCIATION AND IT IS HOPED THAT NEW ENGLAND ANESTHETISTS WILL CO-OPERATE IN MAKING THIS MEETING A BIG SUCCESS. THERE ARE MANY NEW ENGLAND ANESTHETISTS WHO ARE NOT MEMBERS OF THE A. A. A. AND THESE SHOULD JOIN AT ONCE AND HELP IN PROMOTING THE INTERESTS OF THEIR SPECIALTY.

UNDOUBTEDLY SOME OF THESE ANESTHETISTS HAVE BEEN MAKING INTERESTING AND VALUABLE RESEARCHES AND CLINICAL OBSERVATIONS. BY ALL MEANS THEY SHOULD PREPARE PAPERS ABOUT THEIR LATEST ACHIEVEMENTS AND REQUEST A PLACE ON THE PROGRAM FOR PRESENTING THEIR CONTRIBUTIONS.

GENERAL ANESTHETICS FOR INTRA-ORAL OPERATIONS.*

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CINCINNATI, OHIO.

There are many factors in the administration of anesthetics for intra-oral surgery which make the technic one of the most difficult to be attained.

DIFFICULTIES.

The obvious necessity of administering the anesthetic with the mouth open causes a radical departure from the closed and semi-closed methods. The vapor or gases must be sufficiently rich and under pressure to force out the atmospheric air from the pharynx.

The small field of operation in which the anesthetist, operator and assistant have to work, makes the administration much more difficult than if the anesthetist had the whole head to himself. The unavoidable hemorrhage complicates the administration and requires supervision and cooperation with the operator's assistant, whose duty it is to keep the blood and mucous aspirated from the pharynx. The forcing down of the jaw during the operation interferes with the respiration and is another point for the anesthetist to watch. It can readily be seen that the successful administration can be attained only by the closest observation and

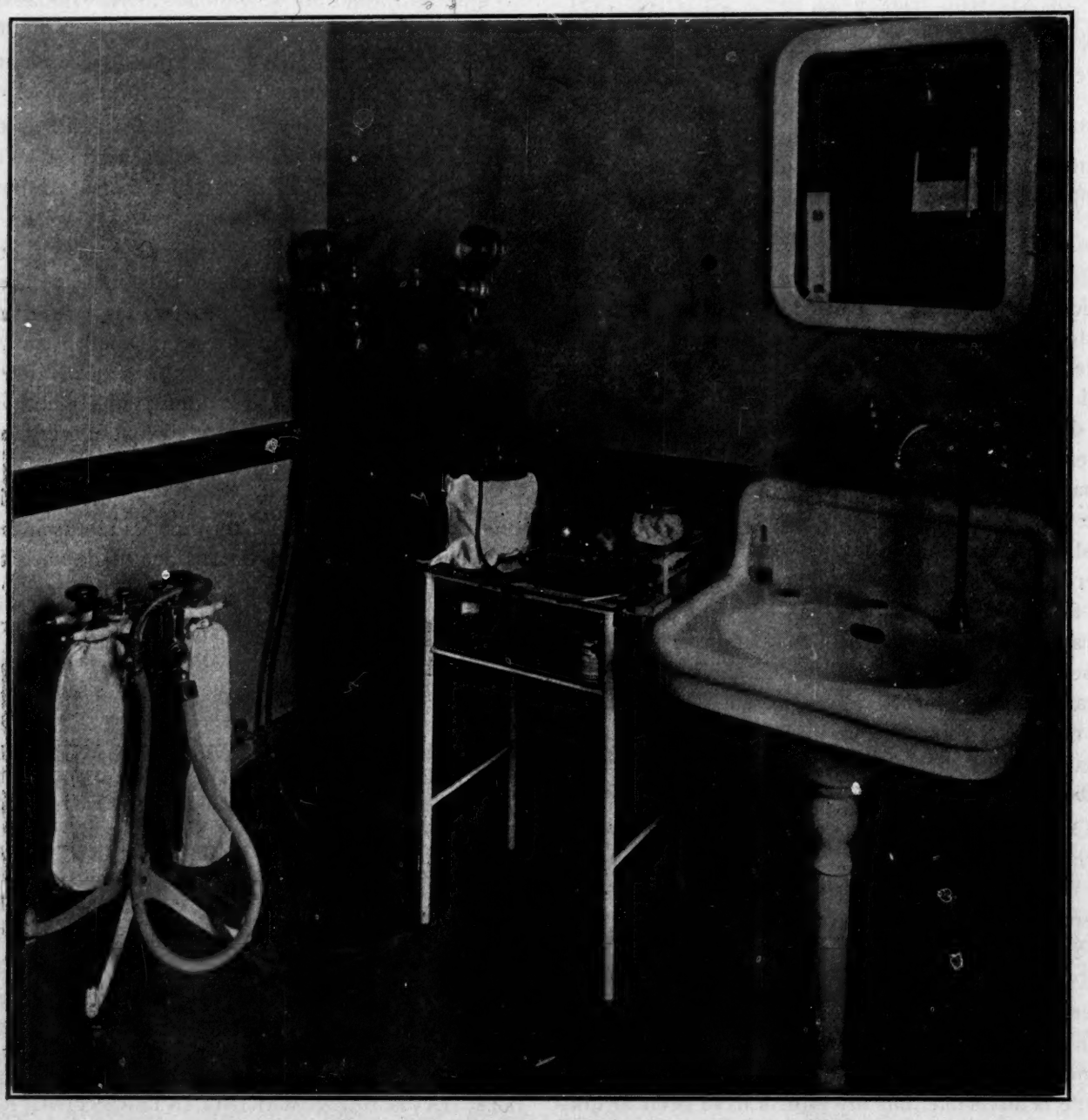

Fig. 1—Anesthetic and emergency equipment.

*Read before the Section on Anesthesia for Dentistry and Oral Surgery of the Interstate Association of Anesthetists, during the Sixth Annual Meeting, at Cincinnati, Ohio, September 15-17, 1919.

cooperation of every one concerned, and the checking up of each other during the operation.

CHOICE OF THE ANESTHETIC AND POSTURE.

The choice of the anesthetic depends primarily upon the patient's physical condition, and secondarily upon the individual anesthetist. Chloroform produces a beautiful anesthetic for mouth work, but the high mortality and frequent postoperative complications contraindicate its use. The committee on anesthetics appointed by the American Medical Society, in 1912, reported the use of chloroform as an anesthetic as no longer justifiable, and that for minor operations its use should cease.

N_2O-O and ether, alone or in combination, are the anesthetics of choice. Nitrous oxid-oxygen used with the nasal inhaler, is ideal for short operations. In long operations, especially when the nasal fossæ or antrum are opened, it is necessary to use ether in combination with the gases. This is administered best by the ether attachment on the gas machine. For resection of the jaw, removal of large cysts of the ramus, resection of nerves and any operation involving the tongue, the writer prefers the ether vapor by the intrapharyngeal method. The vapor can be controlled much more easily, due to the air dilution from mouth breathing.

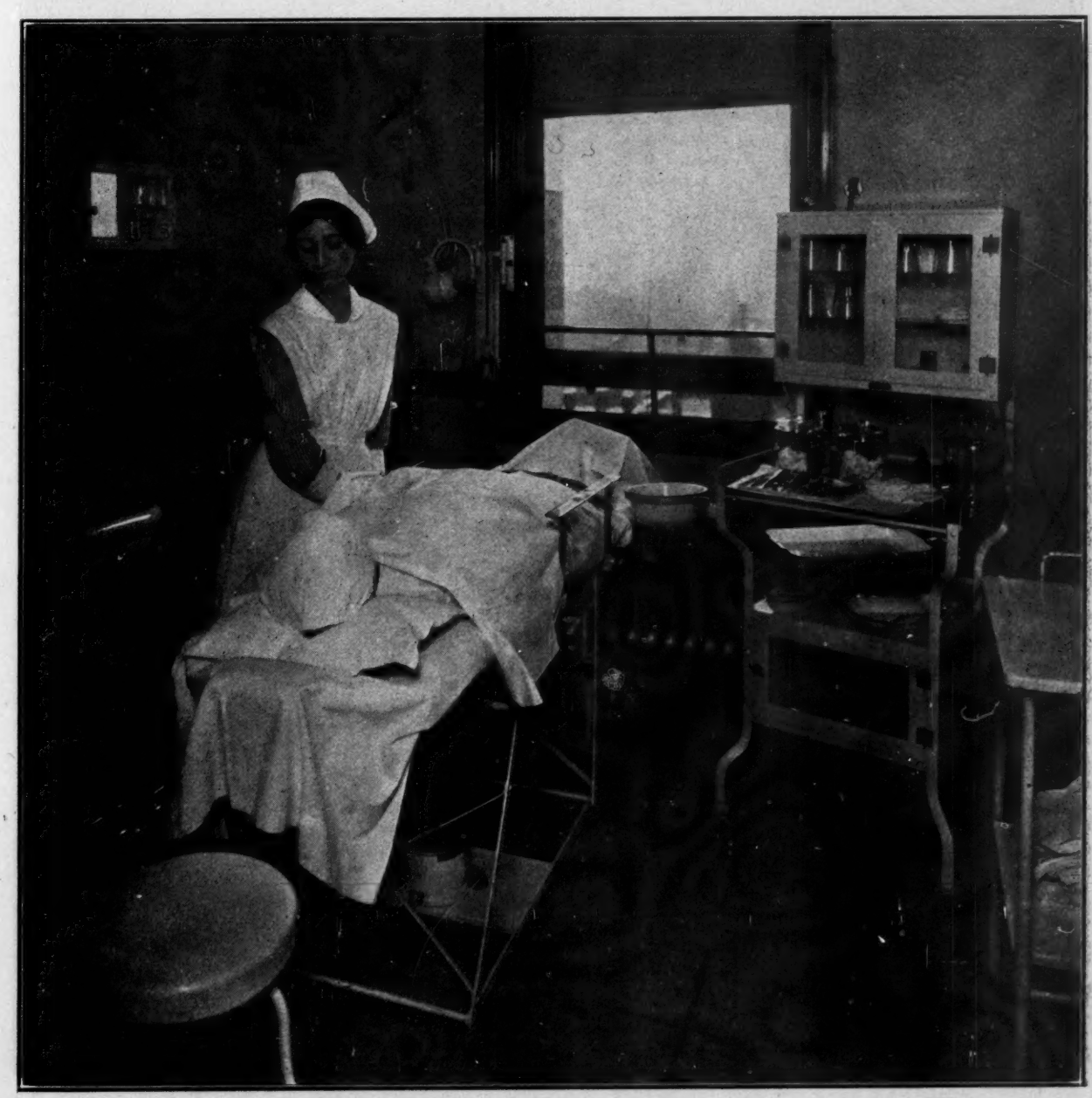

Fig. 2—Operating table with patient in horizontal position. Table has been equipped with arms, making possible its use as a treatment chair in any position. It has been lowered six inches which allows operator to be seated if desired. Strap is placed just above knees, and cuffs which are attached to table are placed on wrists.

For any operation in the mouth, including the extraction of teeth, where a general anesthetic is indicated, the dental chair is replaced by an operating table. By this method the head can be placed in any position suitable to the operator and the anesthetist has a better view of the patient and

reflexes. Should the patient become hard to manage during the anesthetic, he can be restrained easily. The lower jaw can be held forward, which sustains an open airway. If a tooth is accidentally lost from the forceps it is less liable to enter the larynx. When the proper aspirator is used and the throat is packed, there is as little danger of blood being aspirated into the bronchi as when the sitting position is used. The circulation is much better as is the respiration. Due to this fact there is less danger of cerebral anemia.

It is a fact that N_2O has been given thousands of times by dentists without a physical examination or taking of blood pressure. While this fact proves the safety of the anesthetic, it does not justify the practice.

PRELIMINARIES.

In preparing a patient for a short operation it is advisable that the stomach and bladder be emptied and all tight clothing loosened or removed, the latter being the duty of the assistant. All emergency and anesthetic equipment are in proper place before the patient is brought into the operating room. After the operating table is in position and the patient instructed in breathing through the nose with the mouth open, the mouth-gag is placed in position, the nasal inhaler adjusted and the niterous oxid turned on. After the patient is under the influence of the anesthetic, the back of the mouth is packed with gauze and the operation begun. Enough pressure must be present to force the gases into the post-nasal pharynx.

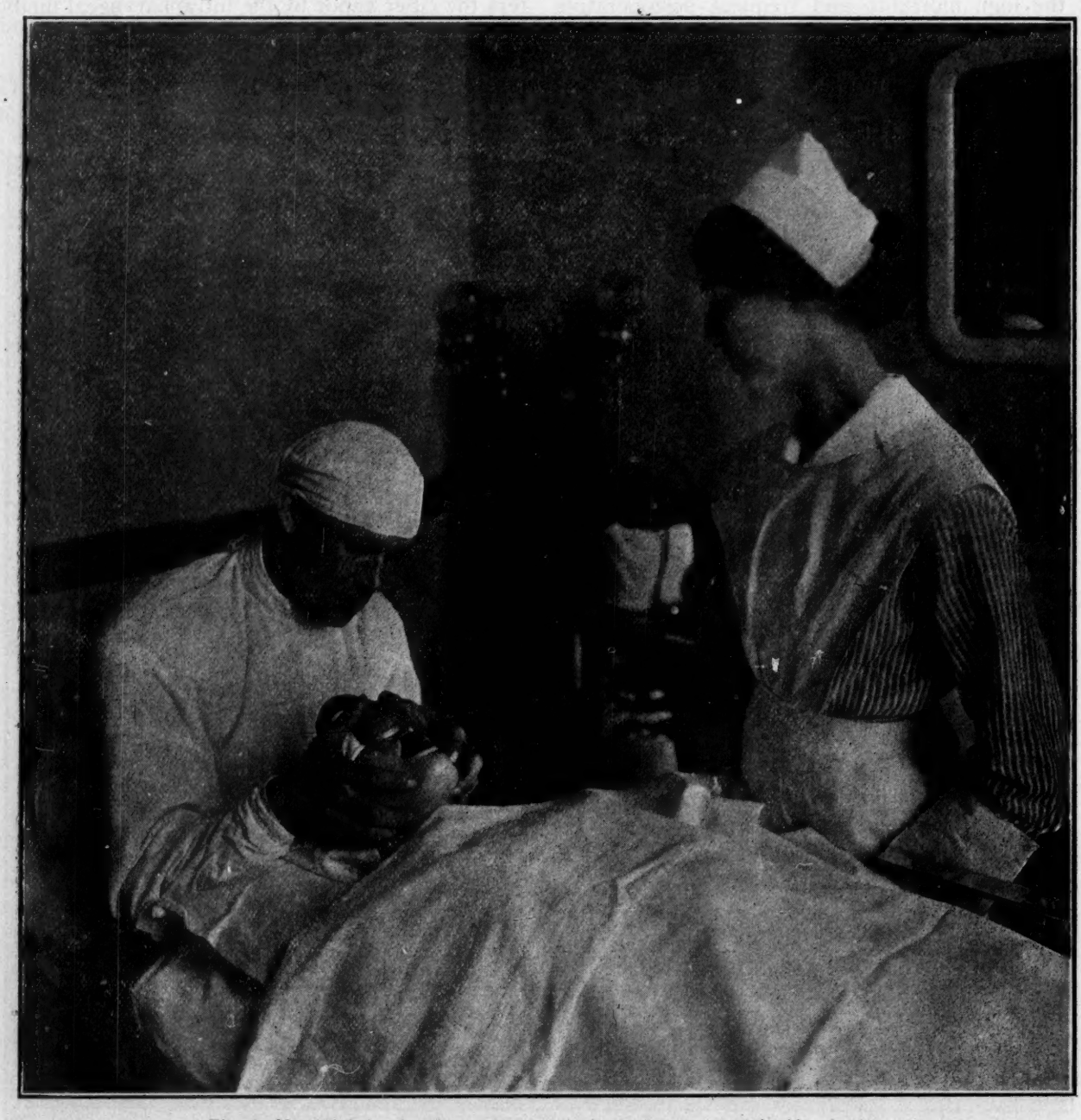

Fig. 3—Nasal inhaler in place. All anesthetic equipments on left side of table.

For a long operation the patient is prepared as though it were a laparotomy. There must be an examination of the heart and lungs and if ether is to be used, a urine analysis. This should be routine work as no one can prognosticate the outcome of an anesthetic. If the anesthetist is a dentist and not qualified to make these examinations, the patient should be sent to some one who has the proper qualifications. The patient usually comes into the hospital the night before the operation, when a light meal is allowed, followed by a cathartic. An enema is given on the morning of the operation. By following this rule you are positive of the patient's diet and run no risk of vomiting which retards the anesthetic and may be inspired by the bronchii causing complications. The patient is brought into the operating room in an operating gown. The anesthetist is sterile, as is the operator. When ether is to be used no premedication is necessary; but when N_2O-O alone is to be used, an H. M. C. tablet is given one-half hour before the anesthetic.

When intrapharyngeal anesthesia by the vapor method is indicated, N_2O-O ether is given as a sequence. A surgical plane of anesthesia must be induced before the catheters, which are moistened with sterile water or vaseline, are introduced into the post-nasal pharynx. A good rule given by Conell is that the length of the catheters is equal to the distance between the alae of the nose and the auditory meatus. Care should be taken that this rule is observed or the vapor will enter the eso-

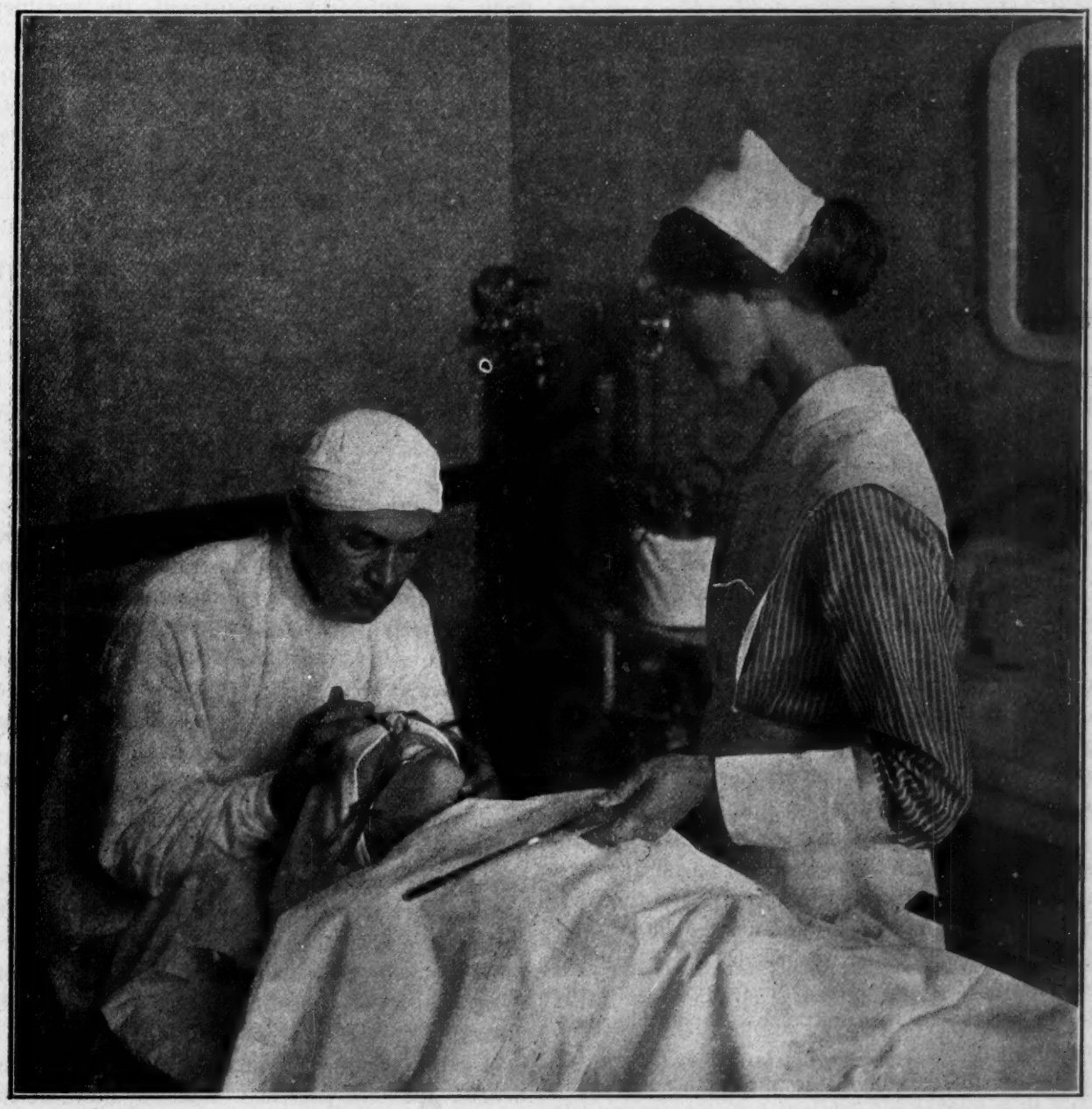

Fig. 4—Nasal tubes in place with back of mouth packed with gauze. Position of nurse who keeps blood aspirated from the field of operation, is at the left of the anesthetist.

phagus and dilate the stomach and the patient will come out of the anesthetic.

ANESTHETIST AND OPERATOR?

No dentist or surgeon should act as both anesthetist and operator, and he who does so is not giving his patient the maximum of safety. Even if the anesthetic is to be what seems a simple extraction, this should be done in a surgical-like manner; not destroying bone and tissue because of the limited time the patient can be kept under the anesthetic. We are removing roots of teeth and necrosed bone due indirectly to the limited time that the operator has had for work. The majority of extractions are devitalized teeth which are very brittle and apt to break. This often necessitates a resection of the buccal plate of the jaw in order to remove them properly. This requires time and undivided attention. A dentist giving N_2O-O for an extraction, even with the assistance of a competent nurse who is not a trained anesthetist, can not give his undivided attention to the operation. If complications arise during the operation, caused by a poorly-administered anesthetic, the operation is generally a failure, which could have been prevented by the employment of a skillful anesthetist.

SURROUNDINGS AND EQUIPMENT.

The use of suggestion at the proper time is a great factor in the successful administration of anesthetics. Few indeed are the people who are not nervous and apprehensive when the necessity for an anesthetic actually arises. One of the duties of the successful anesthetist is to allay these fears. The assistant can do much by her manner to inspire confidence. Every thing must be matter of fact with no loud talking, whispering or professional discussion by those in attendance. No straps are placed on the patient before he is anesthetized, when a strap is placed just above the knees, and cuffs which are attached to the table are placed on the wrists to keep the arms from dropping over the sides of the table which may cause a possible pressure paralysis.

It is difficult to administer anesthetics in a hospital which has no special anesthetic equipment. It has been the practice of some dentists to send their patients to the hospital for the removal of impacted teeth under ether. The open method is used, the operator working as long as he can before the patient comes out of the anesthetic, when he is immediately resaturated. This is poor practice as it requires twice the time and anesthetic to do the same amount of work. N_2O-O by the nasal method, or the intrapharyngeal method with ether is indicated.

When there is a question as to the depth of the anesthetic or as to the condition of the patient, give the patient the benefit of the doubt and stop the administration.

Everybody who is giving anesthetics should have all emergency equipment in working order at all times; for in case of accident, providing the anesthetic was properly administered, the anesthetist will not hold himself responsible.

Anesthesia is an art which can be mastered only by special study and each anesthesia should bring one nearer to the high ideal toward which he is working.

UNION CENTRAL BUILDING.

REMARKS ON COTTON PROCESS ETHER FROM PERSONAL EXPERIENCE AND THE REPORTS OF OTHER OBSERVERS.*

JOS. E. LUMBARD, M.D.,
NEW YORK CITY.

My attention was first called to the work done on ether by Dr. James Cotton, of McGill University, Canada, through his demonstration and lecture at the Royal Victoria Hospital on June 14, 1917. This was properly vouched for and reported in the Journal of the Canadian Medical Association for September, 1917.

COTTON'S CLAIMS FOR HIS NEW PROCESS ETHER.

Briefly, Cotton claims to have discovered that if ether is thoroughly purified by means of a new condensation process he has devised, instead of the older method of fractional distillation, it loses its power to produce anesthesia and becomes merely a stimulant narcotic, somewhat similar in its effects and actions to alcohol. This loss or absence of anesthetic power must therefore be ascribed to something which has been eliminated from the ether during the process of purification. Conversely the anesthetic virtues of ordinary anesthetic ether must depend upon the presence of one or more of these abstracted substances.

Cotton claims, in fact, that two classes of extraneous substances are present in anesthetic ethers. One class, which are desirable, and which favor the production and the maintenance of anesthesia, are really *synergists;* while the others are undesirable *chemical impurities,* which cause postoperative nausea, irritation of the respiratory tract and other

*Read before the American Association of Anesthetists, during the Eighth Annual Meeting, Hotel Grunewald, New Orleans, April 26-27, 1920.

untoward symptoms commonly designated as "ether sickness."

The truth or fallacy of Cotton's theories can readily be demonstrated by anyone with the necessary experimental laboratory facilities and a sample of Cotton's purified ether (procurable on request). The anesthetist is hardly the one to test out this phase of the controversy on the subject. However, Cotton's observations on this matter have been corroborated by others and I have had an independent experience along this line myself. I had always been on the lookout for the purest ether obtainable and I finally succeeded in procuring a sample of ether which assayed 99.8 per cent. pure, the remainder being 0.2 per cent. water. To my surprise, at that time, this sample acted upon trial like a very weak ether; it was actually impossible to get a really satisfactory degree of surgical anesthesia with it, in spite of any increased amount administered. The same patients, on whom the pure ether had been used, went under, without difficulty, when a change was made to an ordinary anesthetic ether containing only 96 per cent. ether.

What we anesthetists are after is an ether with enhanced anesthetic power and virtues and not one with any of these qualifications eliminated. If Cotton is correct in his contention, his idea of course opens up the possibility of producing a superior grade of ether by first eliminating all toxic impurities and then by restoring those synergists that favor the production and maintenance of anesthesia.

ETHER ANALGESIA.

What gave Cotton's work more or less of a spectacular aspect was the discovery, as he alleged, that by super-charging the purified ether with the beneficial synergists—ethylene and carbon dioxid, a condition of analgesia, without loss of consciousness can be maintained by the administration of an amount short of that required for surgical anesthesia. It was this ether anelgesia which he demonstrated in several operations upon the occasion previously referred to.

Cotton Process Ether Analgesia is apparently identical with primary anesthesia such as can be obtained with any other anesthetic ether, but it is possible with the new ether to maintain the analgesic state for a much longer time, with the patient fully conscious and with fairly good control of all voluntary muscles. In his experimental work Cotton sought this analgesic property especially as it was hoped it could be used to great advantage in war surgery and would admit of very rapid evacuation of the wounded to the rear even after severe operations. The theory of ether analgesia is based on the fact that on account of the boiling point of absolute ether it is possible to produce an ether-gas-tension in the tissues locally at the point of maximum heat production, which is in the end of the capillaries of the peripheral tissues. An initial vaso-dilatation caused by the ether allows for a saturation of the tissues while a subsequent vaso-constriction maintains the ether-gas-tension and the analgesia.

These phenomena also account for the stabilization of pulse rate and blood pressure during analgesia and anesthesia under Cotton Process ether. Unless the peripheral sensory nervous mechanism is normal and responsive to the effect of ether, ethylene, carbon dioxid and oxygen, it is difficult to produce and maintain a state of analgesia. Thus it may be difficult to obtain analgesia, (short of narcosis) in patients suffering from anemia, hemorrhage, syphilis and prolonged fever.

I have had very little experience with ether analgesia. I have tried it out in a few cases and my experience has been that of others—some appeared to be quite successful while others passed into surgical anesthesia before any analgesia stage could be demonstrated.

ETHER ANESTHESIA.

The possibilities of Cotton Process ether appeal to me as an improved ether for surgical anesthesia, especially if it would reduce irritation during induction and eliminate postoperative ether sickness—things which all anesthetists are striving for.

In casting up results and adjudging them we must of course distinguish between those postoperative effects which may be due directly to the anesthetic and those due to the operation or the patients' pathological condition. Only an open mind backed with the conservative judgment of considerable anesthetic experience can lead to a reliable verdict, since the distinction is sometimes hard to make for even the most experienced.

PERSONAL EXPERIENCES AND CONCLUSIONS.

I shall give you my impressions of the utility and value of Cotton Process ether from an experience of over 400 cases in which I have used it personally and I shall amplify my views with those of other expert anesthetists of large experience, who have kindly sent me their opinions. You can accept our verdicts for what they are worth.

I used Cotton Process Ether, in a general hospital anesthetic service, by all methods except ether-oil colonic anesthesia. From this use I have drawn the following conclusions.

1. It certainly acts like a stronger ether, at least

during the stage of induction, in which there is apparently less irritation of the mucous membranes and less secretion of mucous. During the stage of maintenance I failed to note any special difference, unless possibly that a slightly smaller amount of ether was used.

2. Recovery seemed less disturbed than when using the ordinary ethers and postanesthetic by-effects were minimized.

I think under the use of Cotton Process ether there is more of a tendency to cyanosis, so that many patients have to be more carefully watched. The lesser irritant effect may be noted especially during the induction of anesthesia in children and also when changing from nitrous oxid to ether.

OPINIONS AND CONCLUSIONS OF OTHERS.

FREEMAN ALLEN, M.D., Boston.—I have been using this ether in *selected cases* for the past two and a half months. The cases I selected were: (1) Children about 10 years old and several infants, about 25 cases in all. The operations were mastoids, hernias, circumcisions and appendectomies. I did not use it in any tonsillectomies or throat work. (2) Gynecological cases and female patients generally, who gave histories of previous postanesthetic nausea and vomiting. Of these there were some 20 cases. (3) I have also used it very often in the ether chamber of the Bennett inhaler simply for inducing anesthesia, changing afterwards to some less expensive ether. Also I have used it in the ether attachment of a nitrous oxid-oxygen apparatus in connection with the administration of gas-oxygen. I have also used it in a few cases of closed ether with the Bennett inhaler throughout.

I have had no experience at all with *analgesia* with this or any other ether, as most of my work is in connection with major surgery.

Making due allowance for the well-known variations in operators, operations, types and conditions of patients, the following impression, based on a small number of cases, is given for any value it may have.

I feel sure that, clinically speaking, it is a superior ether, and that with it I can control patients very easily. I can get along with less of it than with other ethers and in several patients, who, previously had been markedly nauseated with other ethers, the postanesthetic effect of Cotton Process ether has been much less. In children, although I always give atropin first, I find that there is less tendency to mucous secretion and hyperpnea, and that they are readily kept pink. In comparison I would say that from 5 to 6 ounces of Cotton Process ether suffice for the same period of semi-open etherization provided by 8 ounces of other ether.

RAY A. RICE, M.D., Columbus, O.—I have used Cotton Process ether quite extensively by the closed method and think it very good when so given. I do not think it compares with other ethers by the drop-method. It seems to be too gaseous and there is trouble in keeping patients asleep. I have never tried-out its *analgesic* properties, having witnessed an attempted demonstration at another hospital which was quite a failure.

A. S. MCCORMICK, M.D., Akron, O.—I have been keeping some records of the use of various ethers since January. In a series of 106 cases just tabulated, men, women and children patients, operated on, in 5 hospitals, various residences and offices, without selection of cases and working for 37 operators in 27 different kinds of operations, I have found that the average induction time (nitrous oxid-ether and drop-method) to be as follows:

Squibb	6.85 minutes
Cotton Process	3
Mallinckrodt	3.93

The average amounts of the different ethers used for the entire operations were as follows:

Squibb	3.76 ounces
Cotton Process	2.76
Mallinckrodt	2.33

I am sometimes unable to relax certain patients with Squibb's ether and the addition of Cotton Process or Mallinckrodt ether is necessary. I find that a combination of the last two works very nicely in the Ben Morgan apparatus.

Squibb's ether causes considerable mucous secretion in children and also in adults, if no preliminary hypo be given. Mucous secretion is practically absent in children when using Cotton Process or Mallinckrodt ether. Recovery is quickest after Cotton Process ether. Dental cases remain nicely asleep as long as the ether is given but usually awaken within 5 minutes after it is discontinued. It is my opinion that the *analgesia* Cotton obtained is possible only with ether fresh from the laboratory on the morning of operation.

ISABELLA C. HERB, M. D., Chicago, Ill.—It seems to me that the action of Cotton Process ether resembles that of chloroform to a marked degree. I have found that with it the induction period is shorter, that a smaller amount is required for maintenance and that muscular relaxation is more quickly secured than with most other ethers. On the other hand an equally small amount of Cotton Process ether, in my experience, depresses respiration. In other words its action stands midway be-

tween the best anesthetic ethers and chloroform. I have not had time to study its postoperative effects other than vomiting which occurred in about the same number of cases as after Squibb's ether, when properly administered. I used the full open drop-method of administration without previous medication. I did not try it as an *analgesic* because nitrous oxid-oxygen is used in our hospital in the class of cases in which analgesia might be employed to advantage.

C. C. McLEAN, M.D., Dayton, O.—I am more than pleased with my results with Cotton Process ether and I am using it exclusively in my private work when ether is the anesthetic of choice. So far I have used it in almost 400 cases and have found that induction is more rapid, that less is required to maintain anesthesia and that recovery is more rapid than with any other ether. I have only used it in the Ben Morgan and Gwathmey Vapor apparatus, so I cannot say what results would be obtained by the open drop-method. From the nature of the new ether I cannot see how the results with the open method can be as good as when the ether is confined and vaporized as needed. I have not yet seen an ideal apparatus for administering Cotton Process ether.

I have used it as an analgesic with success for opening abscesses, extracting teeth, removing superficial growths and in other minor surgical procedures. Due to its analgesic properties a very light anesthesia may be maintained with Cotton Process ether and I find this better for ordinary work.

FURTHER CONSIDERATIONS.

So far, only one manufacturer has placed Cotton Process ether on the market, but if its superior advantages are demonstrated by further and widespread use, I presume that others are likely to make and market it. Contrary to a current impression there is no secrecy about its composition. Cotton announced its composition to the Canadian Medical Association, The Interstate Anesthetists and published it as a simply pure ether containing more ethylene gas than is found in solution in the ordinary anesthetic ethers. It complies with the standards of the U. S. Pharmacopea, which however makes no mention of ethylene as a synergist. From analysis it has been found that standard anesthesia ethers, which give good clinical results contain 1 per cent. of ethylene by volume, while the Cotton Process ether, as made by the present manufacturer, contains 2 per cent. ethylene by volume, ½ volume of carbon dioxid and 1 per cent. by weight of ethyl alcohol.

As much as 5 per cent. ethylene by volume can be introduced into ether by the aid of cold and pressure, but there seems to be no particular advantage in greatly exceeding 2 per cent. by volume because the excess quickly escapes as soon as the container is opened.

Cotton also mentions carbon dioxid as one of the synergistic anesthetic gases, but such a small amount can be held in solution, compared with what is procurable by means of rebreathing that its use in the new ether is of doubtful value in consequence. Of course the idea immediately occurs to one that if ethylene is the potent synergist it is alleged to be why it should not be used for anesthesia and the ether omitted. Unfortunately and peculiarly ethylene alone does not produce anything resembling an ether anesthesia, it simply, from what I can learn, acts as an inert gas like nitrogen, if given alone. It appears to be necessary to superimpose the action of ethylene upon that of ether in order to get analgesia or anesthesia.

During the experimental period, I understand that Cotton and his anesthetist friends of Toronto, following the example set by Simpson, when he was seeking a substitute for ether, tried out the various laboratory results on themselves and each other. One substance rendered the experiments numb to external sensation for a period of thirty-six hours, but its by-effects were so unpleasant as to render it unsuitable for analgesia for surgical purposes.

It is hoped that the experimental work along this line, initiated by Cotton, will be pursued further in the hope that the general practitioner may eventually have at hand an agent for *analgesia* that is extremely safe, effective and very simple of administration. It is also to be hoped that the endorsement accorded Cotton's work by the Canadian Medical Association will be seconded by the endorsement of those expert anesthetists who have found that the new ether does what is claimed for it.

1925 SEVENTH AVENUE.

If you are interested in co-operating with the N. A. R. S. in keeping and tabulating uniform anesthesia records, get in touch with Mr. T. T. Frankenberg, Executive-Secretary, 16 East Broad St., Columbus, Ohio, and secure a supply of charts for your own personal use and for the hospitals with which you are connected. Occasional surveys of the uniform anesthesia records will provide much of interest and instruction and your co-operation will bring its own reward in the lessons learned.

American Journal of Surgery

QUARTERLY SUPPLEMENT *of* ANESTHESIA *and* ANALGESIA

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F. HOEFFER McMECHAN, A.M., M.D., *Editor*

Avon Lake, Ohio, U.S.A.

OCTOBER EDITORIALS 1920

RESULTS OF A SURVEY BY THE NATIONAL ANESTHESIA RESEARCH SOCIETY OF A SELECTED GROUP OF HOSPITALS TO DETERMINE THE STATUS OF ANESTHETIC SERVICE.*

One of the initial efforts of the National Anesthesia Research Society was a survey of a geographically limited group of hospitals selected with a view of determining the general status of anesthetic service. The following results as compiled, tabulated and charted speak for themselves.

GENERAL RESULTS.

Some 500 Questionnaires were sent out and almost 200 were returned.

Total number of questionnaires received.	181
Questionnaires filled out and analyzed..	147
Returned blank	17
Returned from hospitals using no anesthetics	17
	181

Analysis of questionnaires used:

Number indicating source	143
Number without source	4
	147

Number of hospitals using no anesthetics	17
Returned from hospitals out of business.	3
Returned from hospitals having no records	4
Returned blank	10
Total	181

QUESTION NUMBER ONE.

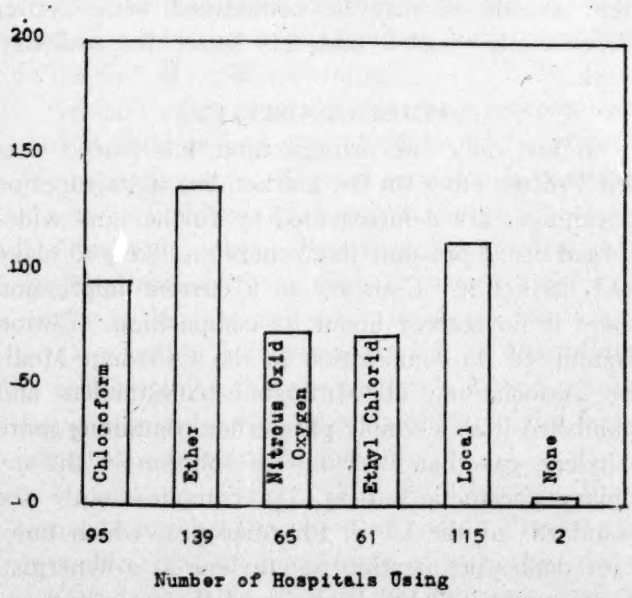
Please Enumerate What Anesthetics Are Employed in Your Hospital?

Analysis of Answers:

Anesthetics.	No. of Hospitals Using.
Chloroform	95
Ether	139
Nitrous oxide-oxygen	65
Ethyl chlorid	61
Local anesthesia	115
None	2
	477

It will be noted that the total number of anesthetics used does not correspond with number of hospitals using, as in almost every case more than one kind of anesthetic is used. This is particularly true in respect to local anesthetics as opposed to general anesthetics, as the uses are still quite different, local anesthetics being more generally used in minor operations.

COMPARISON OF ANESTHETICS EMPLOYED IN VARIOUS HOSPITALS



QUESTION NUMBER TWO.

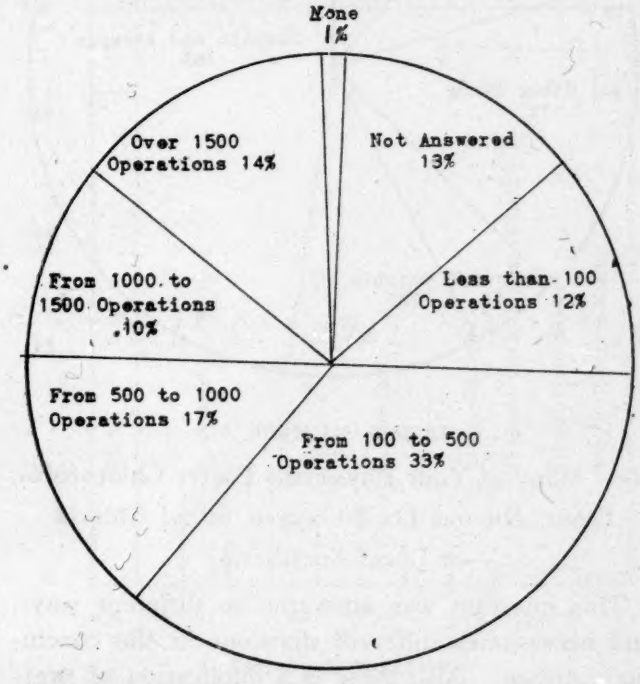
What is the Actual Number of Anesthetics Given During the Year 1919?

Analysis of Answers: These answers have been divided into groups for the purpose of charting, as the number varies with each individual hospital.

*The tabulation and charting of the Questionnaires of the N. A. R. S., were done by *The Business Bourse*, International Inc., New York City.

Number of Operations and Hospitals.		Total Number of Operations.
None to 100 operations	18	784
100 to 500 operations	48	14,384
500 to 1,000 operations	25	17,861
1,000 to 1,500 operations	15	17,306
1,500 to 2,000 operations	13	22,022
2,000 and over	7	19,070
No operations	2	
Not answering	19	
Total	147	91,427

SHOWING COMPARATIVE GROUPS OF HOSPITALS AS TO NUMBER OF OPERATIONS DONE AND ANESTHETICS ADMINISTERED DURING 1919.


None 1%
Over 1500 Operations 14%
Not Answered 13%
From 1000 to 1500 Operations 10%
Less than 100 Operations 12%
From 500 to 1000 Operations 17%
From 100 to 500 Operations 33%

QUESTION NUMBER THREE.

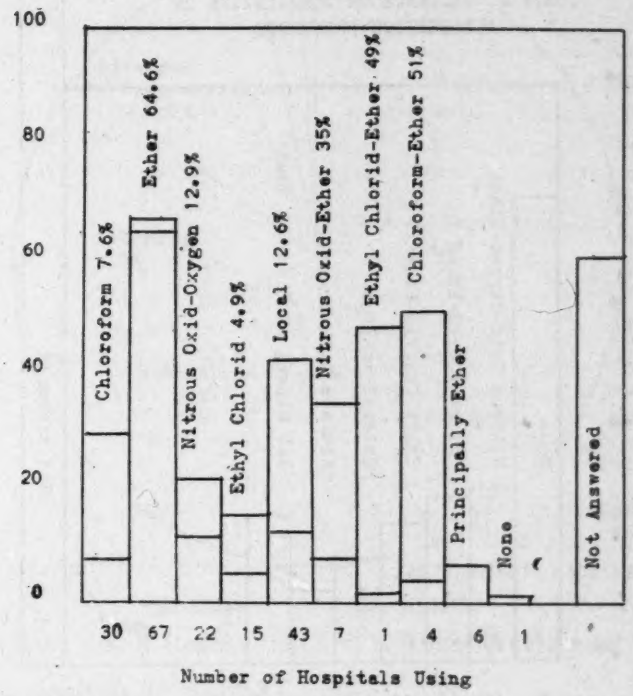
Give Relative Proportion of Use, Stated in Percentages of Number of Cases?

Analysis of Answers:

Anesthetics.	No. Hospitals Using.	Average Percentage of Cases in Which Used
Chloroform	30	7.6%
Ether	67	64.6%
Nitrous oxid-oxygen	22	12.9%
Ethyl chlorid	15	4.9%
Local	43	12.6%
Nitrous oxid-ether	7	35. %
Ethyl chlorid-ether	1	49. %
Chloroform-ether	4	51. %
Principally ether	6	
Not answered	60	
Total	256	

This question appeared to be confusing, as the answers were so worded as to make analysis difficult. In many instances different anesthetics were named, making the total of users higher than the total number of Questionnaires.

RELATIVE USE OF VARIOUS ANESTHETICS AND PERCENTAGES OF CASES



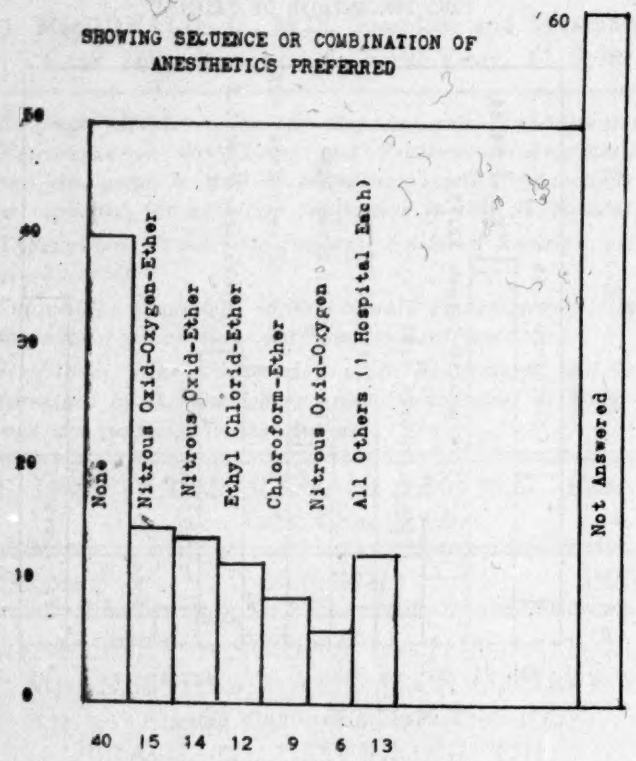
QUESTION NUMBER FOUR.

What Combinations or Sequences of Anesthetics Do You Use?

Analysis of Answers:

Anesthetics.	No. of Hospitals Using.
Not answered	60
None	40
Nitrous oxid-oxygen-ether	15
Nitrous oxid-ether	14
Ethyl-chlorid-ether	12
Chloroform-ether	9
Nitrous oxid-oxygen	6
Ether-oxygen	1
A. C. E. or A. C. E.-ether	1
Ether-oil colonic	1
Ether (open drop)	1
Oil of orange-ethyl chlorid-ether	1
Oil of orange-ethyl chlorid-ether-oxygen	1
Novocaine-adrenalin	1
Cocain-adrenalin	1
Novocain-nitrous oxid	1
Stovain	1
Scopolamin-morphin-ether	1
Cocain-ethyl chlorid-ether	1
	169

In almost every instance in which this question was answered more than one combination or sel quence was reported as used, making the total number of hospitals larger than the number of Questionnaires considered.



QUESTION NUMBER FIVE.

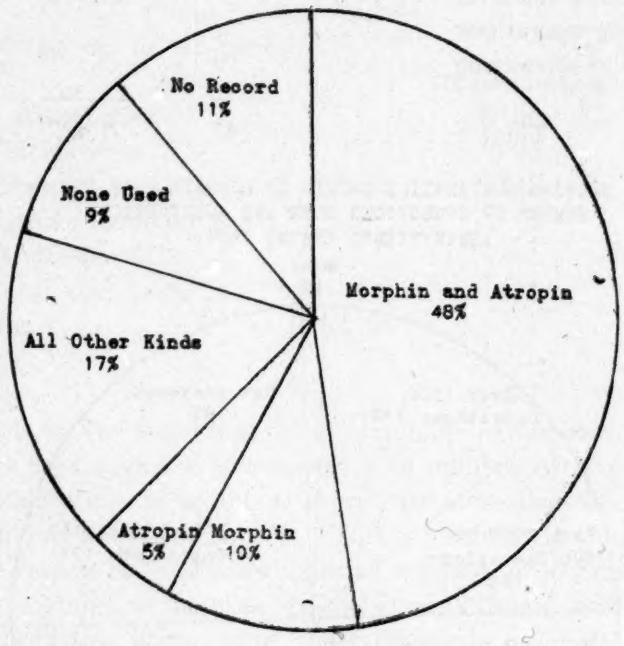
Do You Use Premedication? If So, What?

Analysis of Answer:

Premedication.	No. of Hospitals Using.
No	15
Not answered	19
Morphin-Atropin	80
Morphin	17
Atropin	9
Scopolamin	5
Morphin-Scopolamin	4
H. M. C.	3
H. M. C.-Morphin-Atropin	2
H. M. C.-Morphin	2
H. M. C.-Morphin-Scopolamin	1
Morphin-Hyoscin	1
Chlorotone	1
Ether	1
Codein	1
Scopolamin-Pantopon	1
Hyoscine-Codein	1
Hypo as prescribed	3
Total	166

Many hospitals use more than one kind of premedication, depending on the type of operation and the condition of the patient.

COMPARATIVE KINDS OF PREMEDICATION USED IN VARIOUS HOSPITALS



QUESTION NUMBER SIX.

How Many of Your Physicians Prefer Chloroform, Ether, Nitrous Oxid-Oxygen, Ethyl Chlorid or Local Anesthesia?

This question was answered in different ways, and necessitates different divisions in the conclusions drawn. Also there is a duplication of preference due to the different uses of the anesthetics named, many preferring to use general anesthesia for major operations, while using local anesthesia for minor operations or for nose and throat work.

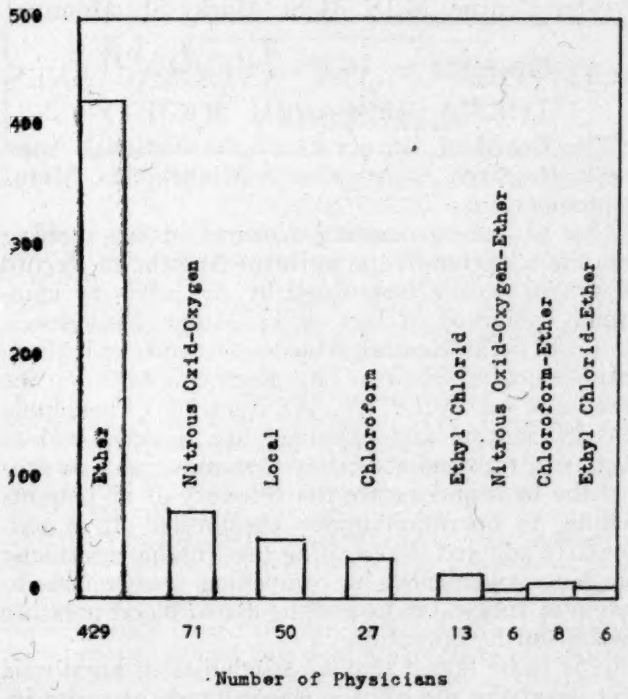
Analysis of Answer:

Anesthetics.	No. of Physicians Preferring.
Chloroform	27
Ether	429
Nitrous Oxid-Oxygen	71
Ethyl Chlorid	13
Local	50
Nitrous Oxid-Ether	6
Ethyl Chlorid-Ether	6
Chloroform-Ether	8
Not answered	23
Total	633

Number of hospitals in which the number of physicians is not specified.

Anesthetics.	All Use.	Few Use.	Majority Use.
Chloroform	6	1	3
Ether	40	—	20
Nitrous Oxid-Oxygen	6	6	—
Ethyl Chlorid	2	8	—
Local	13	7	—
Chloroform-Ether	1	—	1
Total	68	22	24

COMPARISON OF ANESTHETICS ACCORDING TO NUMBER OF PHYSICIANS PREFERRING SAME



QUESTION NUMBER SEVEN.

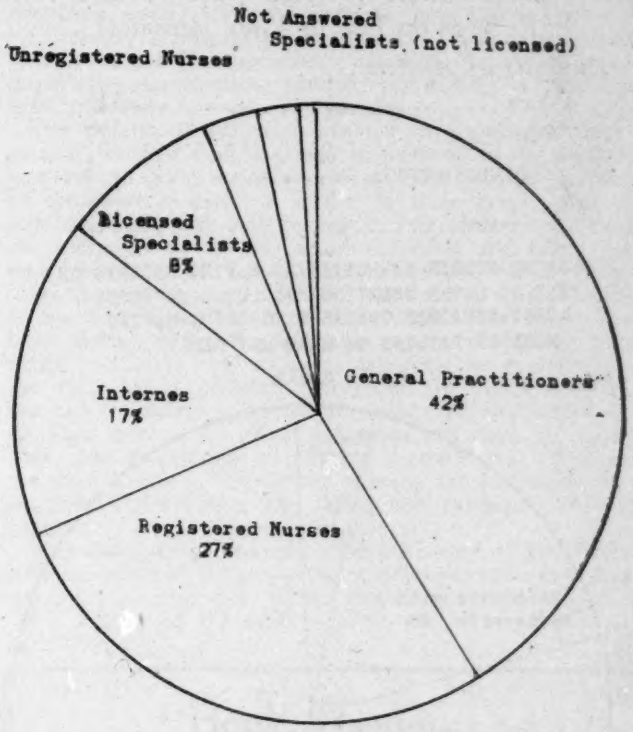
By Whom Are Your Anesthetics Regularly Administered?

Analysis of Answer:

By Whom.	No. of Hospitals.
General practitioners	89
Internes	30
Registered nurses	59
Unregistered nurses	7
Licensed specialists	18
Specialists	3
Not answered	6
Total	212

In many instances the hospitals reporting use two or more persons of the varying types specified. For instance internes, nurses and practitioners may administer anesthetics in the same hospital.

SHOWING BY WHOM ANESTHETICS ARE ADMINISTERED IN PERCENTAGES



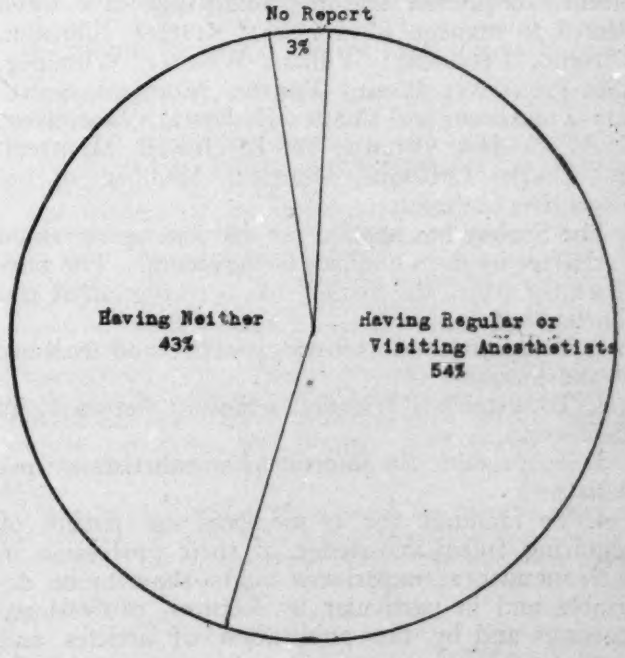
QUESTION NUMBER EIGHT.

Have You a Regular Staff or Visiting Anesthetist?

Analysis of Answer:

Yes	79
No	63
Not answered	5
Total	147

SHOWING COMPARATIVE NUMBER OF HOSPITALS HAVING A REGULAR STAFF OR VISITING ANESTHETIST OR NOT ANSWERING



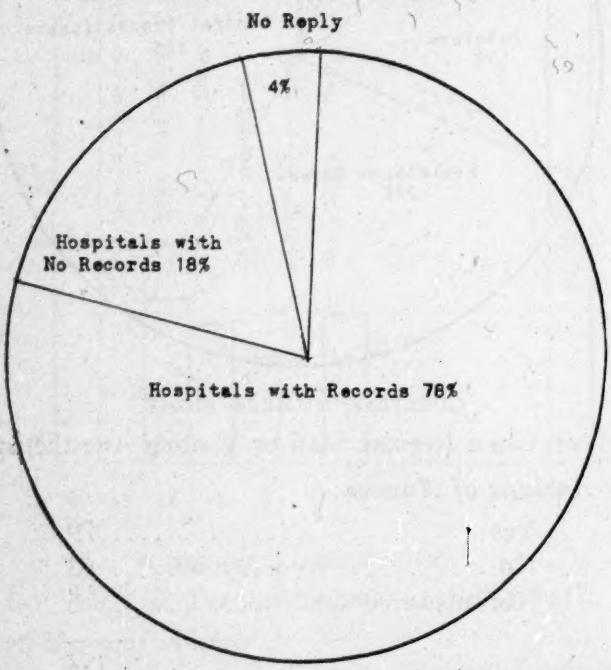
QUESTION NUMBER NINE.

Are Your Answers to This Questionnaire from Records on File in Your Hospital?

Analysis of Answer:

Yes	115
No	27
Not answered	5
Total	147

SHOWING NUMBER OF HOSPITALS HAVING RECORDS ON FILE TO COVER QUESTIONS INCLUDED IN THESE QUESTIONNAIRES COMPARED TO THOSE HAVING NONE OR FAILING TO MAKE ANY REPLY



CANADIAN SOCIETY OF ANESTHETISTS.

The Canadian Society of Anesthetists has been recently organized and the following have been elected to manage its affairs: Samuel Johnston, Toronto, President; William Webster, Winnipeg, Vice-President; Wesley Bourne, Montreal, Secretary-Treasurer; and Charles H. Bastin, Vancouver; G. M. Geldert, Ottawa; W. B. Howell, Montreal, and Charles LaRoque, Montreal, Members of the Executive Committee.

The Society has applied for and has been granted a charter by the Canadian Government. The purposes for which the Society has been organized and chartered are:

1. To promote the science, practice and teaching of anesthesia.

2. To establish friendly relations between its members.

3. To promote the interest of anesthetists as specialists.

4. To facilitate for its members the means of acquiring fuller knowledge of their profession in such manner as experience might show to be desirable and in particular by lectures, professional meetings and by the publication of articles and papers relating to the science, practice and teaching of anesthesia.

Membership in the Society is divided into four classes, fellows, ordinary, associate and honorary members.

The Society will hold its first scientific meeting in 1921.

The officers of the new Society are all well known to the anesthetists on this side of the border and some of them have been accorded the highest distinctions within the gift of the anesthetic associations of the United States. There is no doubt that under their guidance and fostering care that not only the Society but the specialty of anesthesia will come into its own in Canada.

All those who are interested in becoming members are requested and urged to get in touch with Wesley Bourne, M.D., 34 St. Marks St., Montreal.

ACTIVITIES OF THE NATIONAL ANESTHESIA RESEARCH SOCIETY.

The Board of Governors of the National Anesthesia Research Society met in Minneapolis, Minn., September 5-6.

One of the outstanding features of the meeting was the adoption of the uniform Anesthesia Record as drawn up and submitted by the advisory committee composed of Drs. A. H. Miller, Providence, R. I.; E. I. McKesson, Toledo, O., and A. F. Erdman, Brooklyn, N. Y. This Record is based on the standards set by Dr. W. W. Keen of Philadelphia and its routine and extended use is calculated to become a tremendous safety-first movement to protect the lives and assure the recovery of all patients coming to operation under anesthesia. It is particularly adapted to obviating preventable anesthetic accidents and deaths by compelling proper classification of surgical risks and the use of blood pressure guides during operation.

It is to be hoped that all specialists in anesthesia will begin the use of this Record and see to its introduction into the hospitals they serve.

Page proofs of a Monograph on "Nitrous Oxid-Oxygen Analgesia and Anesthesia in Normal Labor and Operative Obstetrics," just off the press, were shown and it was announced that it would be completed and available in a few weeks. This Monograph represents the first of a series to be devoted to certain phases of anesthesia and analgesia as they apply to the several specialties in medicine and dentistry.

Drs. Isabella Herb, A. H. Miller and the Editor of the SUPPLEMENT were selected as judges to award the prizes for the best research papers in anesthesia to be presented at the Pittsburgh meeting.

The N. A. R. S. has decided to investigate all reported accidents and deaths under anesthesia with a view to determining their causes and if possible providing the information that will prevent their recurrence. Anesthetists, surgeons, specialists and dentists are urged to report their cases to the N. A. R. S. with every assurance that their source of origin, if desired, will be kept strictly confidential.

THE AMERICAN YEAR-BOOK OF ANESTHESIA AND ANALGESIA.

As this issue of the SUPPLEMENT goes to press page proofs of the new Year-Book, covering the advances in anesthesia and analgesia for 1917-18, are in the hands of the Editor. Copies of the Year-Book will shortly be available and judging by the scope of the subjects covered and the authority of the contributors and the wealth of illustrations it should surpass the expectation of those who found the first edition of the Year-Book so serviceable.

Owing to the extremely high cost of publication and the rapid rise of prices no price has as yet been made for the new Year-Book but every effort will be made to make the price as reasonable as is consistent with the cost of production.

Send in your advance order now as the edition will be limited and there is every prospect that it will be sold out in a short time.

Medico-Legal Aspects of Anesthesia

USING UNFIT ETHER—RULES OF LIABILITY AND EVIDENCE.

The Supreme Court of Minnesota, in an action brought against the manufacturer of a certain ether and two surgeons, who used it, (in 176 N. W. R. 16) affirms an order denying the surgeons a new trial after a verdict was rendered against all of the defendants, in which a young man in good general health submitted to an operation by the surgeons, for the removal of his tonsils, and he never recovered from the administration of the ether, but died as a result in a few hours. That there was fault somewhere, the court says, was clear. On a former appeal taken by the manufacturer, this court held (141 Minn. 154; 169 N. W. 541) that there was evidence to sustain a finding that the ether was unfit for use, that its use was dangerous to life, that the manufacturer was negligent in putting it on sale, and that its use was a proximate cause of the patient's death. One of the defendant surgeons testified that during the operation the patient came out rather quickly from the ether, so he administered a little bit more, but noticed that it was hard fully to relax the patient, who seemed to resist every time an attempt was made to remove the tonsils, and the witness did not llike to push the anesthetic because when he did push it a little the patient became cyanotic. The other surgeon said the trouble was of such a nature that if the operation had not been partly completed and it had been a long operation he would not have finished it; would not, if it would have taken half or three quarters of an hour. But there was evidence that the administration of ether extended over three-quarters of an hour. Moreover, it was alleged that there was want of proper care after the operation in that, very soon after it, cyanosis appeared and the patient was in a very critical condition until about noon, when he died, and that the defendant surgeons neglected to give him the constant care which the critical nature of his case required. The court holds that the evidence in the case was sufficient to sustain a finding that the surgeons were negligent in administering to a patient ether that was unfit for use, and in their care after the ether was administered.

The skill and diligence which the law requires of a physician or surgeon is such as is usually exercised by others of the same school. He is not necessarily liable for malpractice because of a bad result. He must often act promptly, on his best judgment, and he is not liable for injuries arising, without negligence from honest errors of judgment. But this is an exception to general rules of negligence and the exception is not absolute. Every act of his is in a sense an exercise of judgment and usually of honest judgment. Yet it may be negligent. He might be honest in his judgment that he could leave certain details to an assistant and yet be liable for negligence in doing so. He is liable if his mistake of judgment is so gross as to constitute negligence. He is bound to observe plain physical laws; or he may be liable when his wrong concerns physical facts and is governed by ordinary principles of intelligence. If a surgeon persists in the use of an anesthetic after warning which would impel one of reasonable prudence to desist, he should be held to answer for the consequences.

The defendant surgeons insisted that since no expert witness testified that they did or omitted to do anything contrary to good surgery and practice, it was the duty of the court to direct a verdict in their favor. But the supreme court does not concur in this contention. From the testimony of the defendant surgeons, and from common knowledge of physical facts and laws, the jury might infer that if they had desisted from the use of the ether at the first sign of danger, the patient's life might have been spared, and that reasonable prudence required them to do so. It is only in cases wherein the evidence and the facts to be deduced therefrom are undisputed, and the case concerns a matter of science or specialized art, or other matters of which a layman can have no knowledge, that the opinion of experts is conclusive. This was not such a case. For similar reasons the testimony of a physician exonerating the defendant surgeons was not conclusive.

Nor was it error to receive the testimony of a physician as to the effect of the use of ether from the same container on the following day. That testimony tended to show the character of the ether.—(*Jour. A. M. A.*, September 11, 1920).

Book Review

Oral Anesthesia: Local Anesthesia in the Oral Cavity: Technic and Practical Application in the Different Branches of Dentistry. By KURT H. THOMA, D.M.D., Assistant Professor of Oral Pathology and Member of the Research Department, Harvard University Dental School, etc. *Second Edition*, Revised with 79 illustrations. M. C. CHERRY, Publisher, 22 Seymour St., Boston, 1920.

The continuous demand for Thoma's Oral Anesthesia has made it necessary for the publishers to issue a new edition and the author has used this opportunity to entirely rewrite his work. The volume is now opened with a description of the nature of pain and fear, the two emotions which are so closely related and which have such a profound effect upon the patient. It is no longer sufficient to control pain alone and the successful anesthetist and operator must be able to secure a helpful and cooperative attitude on the part of those coming to operation.

Thoma has always differed somewhat from other authorities on the dosage of procain and suprarenin and in his present edition he emphasizes the value and safety of the T. and H. tablets especially prepared to meet his requirements.

The technics of the injections described in the first volume have stood the test of time, but newer methods have since been developed and have been incorporated in this second edition. The extraoral methods, which are of great value in war surgery and extensive oral operations in general, are described in careful detail and many new illustrations have been added to make the text more comprehensive or to replace obsolete ones. The chapter on Ill Effects, Failures and Accidents, and Postoperative Sequelæ has been entirely changed, more careful considerations, experience, and research work having done a great deal toward a better understanding of these conditions.

Thoma's book is of equal value to the operator, teacher and student. It is invaluable to those who wish to perfect themselves in oral anesthesia and Thoma advocates nothing short of the perfection he, himself, has striven for and attained.

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